SCIENCE ABSTRACTS.

Section A.—PHYSICS.

APRIL, 1928.

GENERAL PHYSICS.

781. Simple Seismic Apparatus. P. Kirkpatrick. *Nat. Research Council, Bull.* 61. *pp.* 91–96, *July,* 1927.

To replace the falling columns of Mallet and others for determining seismic forces, an apparatus consisting of a bar so supported that it is free to fall in one direction only is described. The mathematical theory of the instrument and the likely sources of error are examined. W. A. R.

782. Tests of a Seismograph. J. Lacoste. *Comptes Rendus,* 185. *pp.* 469–472, *Aug.* 22, 1927.

A Galitzin instrument was tested by applying harmonic motions to a table. There was a considerable divergence between calculated and actual motions that could not be attributed entirely to the galvanometer. Experiment indicated that the divergence was largely the effect of the electromagnetic damping of the pendulum. Further experiments involving damping by liquids gave the same differences. It is concluded that the coefficient of damping, hitherto regarded as constant, is a function of the velocity. W. A. R.

783. Anemometer Theory. E. Ower and W. J. Duncan. *Journ. Sci. Instruments,* 4. *pp.* 470–475, *Dec.,* 1927.

A new method of correcting the readings of a vane anemometer for changes of air density is shown, and some experiments are described for the determination of the force coefficient K for anemometer blades.

Authors.

784. Measurement of Moisture Movements in Building Materials. F. L. Barrow. *Journ. Sci. Instruments,* 4. *pp.* 475–480, *Dec.,* 1927.

The paper deals with two forms of apparatus in use at the Building Research Station for the measurement of the expansion of building materials under the influence of moisture. The two forms of extensometer used to magnify the displacements of the specimen are described in detail. The movements may be recorded autographically; and the apparatus may be adapted for measurements due to changing humidity of the air or on immersion in water. Author.

785. Automatic Humidity Control. W. H. Apthorpe and J. J. Hedges. *Journ. Sci. Instruments,* 4. *pp.* 480–483, *Dec.,* 1927.

It is often necessary to maintain constant atmospheric humidity in

rooms where hygroscopic substances such as textile materials, tobacco, paper, etc., are being tested or stored, or for the seasoning of timber and the preservation of foodstuffs. The control described in this paper is based on the principle of the ordinary hair hygrometer, and has been designed to operate electrical relays which govern the supply of dry or moist air necessary to preserve constant humidity in an enclosure.
AUTHORS.

786. The Aspiration Psychrometer. H. Ebert and A. Pfeiffer. *ZS. f. Phys.* 46. 5–6. *pp.* 420–426, 1928.

A complete expression for the relative humidity of the air has been derived by an exact consideration of the quantity of water which saturates the air around the wet-bulb thermometer. This expression agrees well with the general expression used by Sieper. In a table values of the relative humidity obtained from the authors' formula are set out for dry-bulb temperatures from 40° to 150° C. and psychrometric differences of 0° to 105° C. for a total pressure of 760 mm. Hg. Comparison with the table given formerly [Abstract 2437 (1927)] shows larger values for the relative humidity for given dry-bulb temperatures and psychrometric differences, amounting to 2·5 %. The new values are in very close agreement with those obtained from Sprung's original formula. It is stated that the new values give a greater accuracy than could be obtained by the earlier method where results for higher temperatures were obtained by interpolation graphically.
R. S. R.

787. Machine for Measuring the Depth of Deep Wells. C. E. v. Orstrand. *Washington Acad. Sci., J.* 17. *pp.* 481–487, *Nov.* 19, 1927.

Particulars are given of a machine designed to have stability, flexibility and symmetrical distribution of the load on the cable. Two forms are illustrated: (1) For use on field trips to test a well occasionally, and (2) for use when drilling or conducting other deep well operations. Possible sources of error in the use of the instrument are discussed.
R. S. R.

788. Apparatus for Producing Two Superincumbent Layers of Liquid for Use in Diffusion Measurements. G. v. Békésy. *Phys. Zeits.* 28. *pp.* 812–814, *Dec.* 1, 1927.

A form of apparatus comprising a ⊣-shaped tube provided with a tap, and with the two vertical limbs connected to Marcotte bottles, containing the respective liquids, are described. The liquids are delivered to the horizontal limb, and form superimposed layers there with the lighter on top. The process of interdiffusion can be followed by inserting the diffusion vessel in one arm of an interferometer. The following values of the diffusion constant of the respective pairs of liquids were determined: $\frac{1}{4}N$ carbamide-water at 17·19° C., $117{\cdot}1 \times 10^{-7}$ c.g.s.; $\frac{1}{4}N$ sodium chloride-water at 13·15° C., $111{\cdot}1 \times 10^{-7}$ c.g.s.
J. S. G. T.

789. Investigation of Some Technical Viscometers. S. Erk. *Zeitschr. f. tech. Phys.* 8. 12. *pp.* 595–599, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The determination of the viscosity of mineral oils in technical viscometers, such as the Engler, is not sufficient for present requirements. It is necessary to determine the viscosity in absolute units (Poises). A series of determinations of the viscosities of aniline from − 5·5 to 120, of nine mineral oils between 0° C. and 70° C. and of rape oil between 20° C. and 40° C., were made. By means of these standardised oils it is possible to calibrate the technical instruments in terms of absolute units. The Engler, Vogel-Ossag, Lawaczeck, and Mitchell viscometers were compared, and their limits of application were determined. F. J. B.

790. Effect of Non-Uniformity and Particle Shape on "Average Particle Size." H. Green. *Frank. Inst., J.* **203.** *pp.* **713–729,** *Dec.,* **1927.**

Although much has been written on methods for determining particle size, little explanation has yet been offered as to the meaning of "average particle size," when this term is applied to materials composed of particles that are irregular in shape and non-uniform in size. Part I of this paper deals with the effect of non-uniformity on average particle size, and it is found (*a*) that there is no general average particle size; (*b*) particle size must be given as some definite average diameter which will depend upon its use; (*c*) non-uniformity introduces complexity but no insurmountable difficulties so long as the mass of particles possess geometrical similarity; (*d*) the natural diameter of a single particle is $6v/s$, where v and s denote the volume and surface, respectively. Part II investigates the effect of shape on uniformity. The use of the formulæ of the average diameters obtained on the basis of geometrical similarity is adopted for all cases of geometrical dissimilarity. It is shown that this step not only simplifies matters, but is permissible when arbitrary values are not assigned to the shape factors. Formulæ for mixtures are given covering all cases. A hypothetical model consisting of three particles of known dimensions is studied and the practical application discussed. H. H. Ho.

791. Present Position of the Question of the Existence of Charges Smaller than the Electron. F. Ehrenhaft. *ZS. f. Phys.* **45. 7–8.** *pp.* **557–560, 1927.**

The collected measurements of the velocities of submicroscopic particles whose densities vary from 0·93 (oil) to 19·2 (gold), show that in all cases the particles are spherical and of normal density. The charges on these particles vary from $4\cdot 67 \times 10^{-10}$ e.s.u. for oil to $1\cdot 04 \times 10^{-10}$ for gold, *i.e.*, they are in some cases much smaller than the electronic charge. [See also Abstract 531 (1927).] G. E. A.

792. Determination of the Error in the Ehrenhaft Method of Measuring the Smallest Charges on Single Test Particles. E. Wasser. *ZS. f. Phys.* 45. 7–8. *pp.* 561–587, 1927.

The evacuation method, which has led to consistent values of the constants in the law of resistance of the medium to the motion of particles, has also brought out in the charges of the particles large deviations from the accepted electronic charge. In order to determine the experimental error of the method, new measurements were made with selenium particles of radial dimensions 10^{-5} to 3×10^{-5} cm. The whole question of the accuracy of the separate observations was then investigated, and it is shown that the deviations of the particle charges from the electronic value cannot be explained either by want of exactness in the measurements or by the manner of using the different resistance formulæ. [See also Abstract 2497 (1926).] G. E. A.

793. Theory of the Spontaneous Division of Microscopical Drops. N. v. Raschevsky. *ZS. f. Phys.* 46. 7–8. *pp.* 568–593, 1928.

The author applies the equations of motion to find the conditions under which small drops may spontaneously sub-divide. Under the assumption that the rate of change of the constitution and size of the drops by chemical changes is small, he finds that (1) if electrical charges are neglected and capillary active substances with powers of absorption are absent, a spherical drop remains stable, and will not sub-divide if its surface tension is positive, but if negative the drop is labile and it changes progressively into smaller drops. (2) If electrical charges are absent, but capillary active substances exist in the drop, then again with positive surface tension the sperical drop is stable; but with negative surface tension, under certain limits of radius, the surface tension may change its sign. The drop is thus labile and spontaneous division occurs until this radius is reached, but then ceases. (3) With electrical charges present the drop is stable when above a certain size and not spontaneously divisible, but if by outside influences this limiting radius is reached, then subdivision occurs. (4) By consideration of the differences of concentration produced in the drop for finite rates of diffusion, the mathematical problem is formulated and calculations show that (*a*) the stable state need not be unconditionally spherical, and (*b*) spontaneous subdivision can occur only for drops above a certain size. R. S. R.

794. Determination of the Molecular Volumes of Liquids at their Boiling Points. A. E. Arbusow. *Zeits. phys. Chem.* 131. *pp.* 49–60, *Dec.*, 1927.

The author describes the apparatus (all glass) which he constructed in 1913 for his investigation of organic phosphorus compounds. The apparatus resembles, as he learnt subsequently, that of L. Meyer and W. Ramsay. With this apparatus he determines the molecular volumes of some alcohols (methyl, ethyl, propyl, butyl, isobutyl), chloroform and benzene, and compares the results with those of previous workers, mostly confirming accepted figures. H. B.

795. Band Vortices and the Theory of Rayleigh. H. Bénard. *Comptes Rendus*, 185. *pp.* 1257–1259, *Dec.* 5, 1927.

In a recent paper [see Abstract 529 (1928)] the author has verified experimentally the theory of Rayleigh for the dimensions of the cellular vortices formed when a thin layer of fluid is heated from below. Rayleigh also considered the possibility of a set of parallel vortices, and the author has obtained these experimentally, and the ratio of their width to the thickness of the layer agrees with that calculated (2 : 1). W. G. B.

796. Phenomena of Water Movements on the Passage of Rapidly Moving Spheres. C. Ramsauer and G. Dobke. *Ann. d. Physik*, 84. 6. *pp.* 697–720, *Dec.* 3, 1927.

A method is now described for the photographic study of the rapid passage of spheres through water at rest. It is found that a hollow space forms in the wake of the sphere which widens radially until an explosion-like return of the entire water mass occurs. The subsequent centrifugal-like movements backwards and forwards constitute a secondary phenomenon. The data have been used for the determination of the water velocity as a function of the sphere velocity and of the distance from the line of impact, the radial velocity being found directly proportional to the former and inversely to the latter. A theoretical discussion of the results and a comparison with previous work [see Abstract 6 (1901)] are included. The paper is copiously illustrated with diagrams and photographs. H. H. Ho.

797. The Influence of a Free Surface and of a Rigid Boundary on the Paths of Quickly Moving Spheres in Water. C. Ramsauer and G. Dobke. *Ann. d. Physik*, 84. 6. *pp*. 721–746, *Dec*. 3, 1927.

A sphere projected at great velocity upon a water surface at a small angle may be reflected, and the path of the sphere in the water has now been determined experimentally as a function of the angle of reflection. After comparison with artillery data, the results appear to be independent of the diameter of the sphere when this lies between 1·1 and 16 cm. A sphere at high velocity moving through water parallel to a free surface is found to be attracted towards the surface, and its path has been determined experimentally as a function of the distance between sphere and boundary surface. For a fixed boundary the sphere moving initially parallel to it is repelled with a force which is a function of the distance apart. In both cases the force is proportional to the square of the velocity, and in the last case inversely proportional to the difference between the distance from the fixed surface of the centre of the sphere and its radius. Theoretical interpretations are attempted. H. H. Ho.

798. Three-Dimensional Disturbances of the Poiseuille Flow. T. Sexl. *Ann. d. Physik*, 84. 6. *pp*. 807–822, *Dec*. 3, 1927.

Recently [see Abstract 2805 (1927)] the author has published certain exact expressions for the stability problem of the Poiseuille flow in axially symmetrical tubes, and a transcendent equation containing certain necessary constants. The latter is now solved for a special case, and the behaviour of the Poiseuille flow then investigated for three dimensional disturbances. It is shown that the essential features in the behaviour of two and three dimensional disturbances are analogous to those in the behaviours of flows with linear and parabolic distributions of velocity respectively. The paper is entirely mathematical. H. H. Ho.

799. Theory of Liquid Flow through Cones. W. N. Bond. *Phys. Soc., Proc.* 40. *pp*. 1–6, *Dec*., 1927.

This paper gives an approximate general solution of the hydrodynamical equations for liquid flow through conical tubes of circular section, the errors due to the approximation being small for converging cones of small angle, and for flow through similar diverging cones till near the speed at which the theory predicts turbulent motion. The theory is compared with experimental results previously published. AUTHOR.

800. Cavitation Due to the Arrest of Water Flow in a Conduit. de Sparre. *Comptes Rendus*, 185. *pp*. 1234–1237, *Dec*. 5, 1927.

The excess pressure due to cavitation in a conduit is investigated mathematically. A. Wh.

801. Equilibrium of a Heterogenous Mass of Fluid. A. Veronnet. *Comptes Rendus*, 185. *pp*. 1441–1443, *Dec*. 19, 1927.

Although it has been shown that the figure of equilibrium of a rotating heterogenous mass of fluid cannot be wholly ellipsoidal, the deviation is small only. In no case can the figure of equilibrium have a point of inflexion on the meridian, and consequently fission into two parts is impossible. A. Wh.

802. Distribution of Velocity and Density in a Rotating Heterogeneous Fluid. E. Merlin. *Comptes Rendus*, 185. *pp*. 1579–1581, *Dec*. 27, 1927.

Obtains some general formulæ. **Errata** (*ibid*. 186. *p*. 332, *Jan*. 30, 1928). W. G. B.

803. Application of the Hertz Theory of Impact to Plastic Bodies. T. Pöschl. *ZS. f. Phys*. 46. 1–2. *pp*. 142–146, 1927.

An attempt to extend Hertz's theory of elastic impact to plastic substances. It is assumed that the resistance to flattening which such bodies oppose is proportional to the relative velocity, and a corresponding term is embodied in the formulæ of Hertz. A convergent series is deduced. The product, duration of impact times relative velocity of the moment of impact, should be constant. The paper is mathematical; experimental confirmation is so far wanting. H. B.

804. Internal Friction in Solids. A. L. Kimball and D. E. Lovell. *Phys. Rev*. 30. *pp*. 948–959, *Dec*., 1927.

It is shown from tests on eighteen different solids, including several metals, glass, celluloid, rubber and maple wood, that the internal friction for strains below the elastic limit does not obey the liquid viscosity law, as is usually assumed, according to which the frictional force depends upon the velocity of strain, but that the internal friction is entirely independent of strain velocity, so far as can be observed. It was found to depend upon the amplitude of strain during the strain cycles and approximately to obey the law: Energy loss per cycle per unit volume equals ξf_m^2. In this expression f_m is the maximum value of the stress during the stress cycle and ξ a proportionality factor, which may be called the internal friction constant. The method used was to measure the transverse deflections of the end of a rod, about a metre long, of the material being studied; the transverse deflections were produced during rotation of the rod when its end was deflected downwards by suitable loads on it. The experiments differ from most previous work in that relatively large masses of material were employed, tending to reduce surface effects, which are likely to enter in the case of vibration decrement experiments on wires and on thin strips. A table of the internal friction constants obtained is given, and also a table of similar internal friction constants calculated from data of previous investigators. A reasonable agreement is found. AUTHORS.

805. Elastic Hysteresis of Steel. P. Rossi. *N. Cimento*, 4. *pp*. 371–378, *Nov*., 1927.

Studies the cycles of bilateral hysteresis obtained by subjecting soft steel wires to flexure beyond the elastic limit, in order to observe the manner in which the areas of the diagrams are enlarged or restricted in the various treatments. Shows how the method can be applied to determine the effects of chilling and wiredrawing. E. E. F. d'A.

806. Change of Compressibility with Pressure. L. H. Adams. *Washington Acad. Sci., J.* 17. *pp.* 529–533, *Dec.* 19, 1927.

The change of compressibility with pressure for crystalline solids is shown to a rough approximation to be dependent on the compressibility itself, the two quantities increasing together. The mutual relation is more obvious if the halides of the heavier alkalies be excluded; 85 % of the remaining observations deviate from a single smooth curve by an amount which is hardly greater than the experimental error. This curve therefore may be used to determine the order of magnitude, at least, of the pressure-coefficient of compressibility, if the mean compressibility over a given pressure-range is known. H. H. Ho.

807. Compressive Strength Dispersion of Materials. J. Tucker, Jr. *Frank. Inst., J.* 203. pp. 751–781, *Dec.*, 1927.

Consists of a study of the strength dispersions of materials, by which is meant those variations from the mean exhibited in the ultimate strength of individual test specimens made of a uniform material under uniform conditions, for which there are no assignable or controllable causes. It is shown that the strength frequency curve is of the normal form or very close to the normal form, sufficiently close, in fact, to permit the normal form to be used in engineering calculations. The magnitude of the strength dispersion is a function of the cross-sectional area of the compressive specimen, *viz.*, the coefficient of variation varies inversely as the square root of the area of the compressive specimen. The strength dispersion of concrete is a function of the age and also of the maximum size of aggregate in the mix. The intrinsic compression strength reliability of concrete is shown to be high, the reliability of the structural element increasing with its size. Radical changes in design are indicated, with great saving in weight of concrete, due to this, especially in very large masses, such as dams. C. O. B.

808. Centre of Non-Parallel Forces. Kolossoff. *Comptes Rendus,* 185. *pp.* 1012–1014, *Nov.* 14, 1927.

If $\vec{F}_1, \ldots \vec{F}_n$ be a system of forces applied at the points $M_1, \ldots M_n$ of a solid and if the centre C be defined by the two conditions $\Sigma(\vec{\rho}_k \vec{F}_k) = O$; proj. $\Sigma(\vec{\rho}_k \vec{F}_k)$ upon $P = O$, where $\vec{P}_k = \overrightarrow{CM}_k$, P being a plane perpendicular to $\Sigma\vec{F}_k = \vec{F}$, then if O be the origin and $\vec{r}_k = \overrightarrow{OM}_k$, $\vec{r}_c = \overrightarrow{OC}$, it is found that

$$\vec{r}_c = \frac{\vec{F}\Sigma(\vec{r}_k \vec{F}_k) + [\vec{F}_1\Sigma(\vec{r}_k \vec{F}_k)]}{F^2}.$$

The point C, which has already been introduced in a more complicated manner by Hamilton, is now shown to possess very important astatic properties which entitle its claim as " centre " to be above that of the centres of Minding, Darboux, and Möbius. H. H. Ho.

809. Equations of Poincaré. M. Četajev. *Comptes Rendus*, 185. *pp*. 1577–1578, *Dec.* 27, 1927.

In this mathematical paper the equations of motion given by Poincaré (*Comptes Rendus*, 132. *p*. 369, 1901) are transformed into the canonical form and into that of Jacobi. H. H. Ho.

810. The Statistical Series of the Charlier A-Type and the Boltzmann Equation. U. Wegner. *ZS. f. Phys.* 45. 7–8. *pp*. 539–547, 1927.

A criterion is deduced for the assumption that a function $f(x, y, t_1, t_2, \ldots t_n)$, symmetrical in x and y, may be best approximated by the Hermite orthogonal functions in the sense of the method of least squares. This criterion may at the same time serve to characterise the function $f(x, y, t_1, \ldots t_n)$. If then $f(u, v, x, y, z)$ be a distributive function of the velocity u, v, and of the space co-ordinates x, y, z (symmetrical in u and v), which satisfies the Boltzmann differential equation and is in u and v of the Charlier A-type, it is proved that it can only be the function $f = C \, . \, e^{2\phi - u^2 - v^2}$, where Φ signifies the potential. E. F.

811. Geometrical Construction of Wing Profiles by Conformable Representation of a Circle. M. Girault. *Comptes Rendus*, 185. *pp*. 1584–1586, *Dec.* 27, 1927.

This paper develops and completes the construction given in a previous publication [see Abstract 876 (1927)]. The process consists in the graphic construction of the function $Z = (z + 1)^2 f(z)/4z$, where z is a point in the plane of a circle whose radius is taken as unity, centre as origin, and Z a point in the plane of the profile transformed from the circle. The $f(z)$ is developed into a series with negative powers of z of the form $f(z) = 1 + a_1/z + \ldots + a_n/z^n$, the constants $a_1, \ldots a_n$, being called the parameters of the profile. The various cases are then considered of the transformed curves, *e.g.*, with one parameter the basal curve is a circle, two parameters give a Pascal limaçon, etc. The differential of the function of transformation gives a basal curve constructed on the same principles, and the modulus of a point of this curve gives the scale of the transformation necessary for the calculation of velocities, whilst the argument gives the angle which enables tangents to the contour to be described. Other cases are discussed. H. H. Ho.

812. Laue Photographs from a Face-Centred Cubic Lattice. M. Majima and S. Togino. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 111. *pp*. 75–76, *Oct.* 25, 1927. *In English.*

Two pages of letterpress accompanied by more than one hundred half-tone reproductions of Laue photographs of aluminium crystals having the cubic axis inclined at angles α, β and γ with the incident X-ray pencil. It is suggested that by comparison of a Laue photograph of a crystal with those reproduced in the paper, the orientation of the crystal can be determined. W. H. Ge.

813. Structure and Dimensions of the Benzene Ring. J. K. Morse. *Nat. Acad. Sci., Proc.* 13. *pp*. 789–793, *Dec.*, 1927.

Discusses the application of the model of the carbon atom previously described [see Abstract 2208 (1927)] to the problem of the structure of the benzene ring. Actual dimensions and details of the structure are proposed. W. H. Ge.

814. Space Group of Potassium, Rubidium and Cæsium Sulphates. F. P. Goeder. *Nat. Acad. Sci., Proc.* 13. *pp.* 793–797, *Dec.,* 1927.

Mentions the work of Ogg and Hopwood, of Bradly and of Vegard. Neither of these has determined the space group. The author has made use of Laue photographs and the lattice constants as determined by Ogg and Hopwood. The only space groups fulfilling the conditions are 2Di−1 to 2Di−16 inclusive, and comparing the observed Laue patterns with the diffraction effects to be expected from these sixteen space groups, it has been found that 2Di−13 (V_h^{13}) is the only one that fits the facts.

H. N. A.

815. Strength of Metallic Crystals. v. Göler and G. Sachs. *Zeitschr. f. tech. Phys.* 8. 12. *pp.* 586–595, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.,* 1927.

Descriptions are given of the methods of preparing and determining the orientation of metallic crystals. In the fracture- and shaping-processes of separate crystals definite crystal surfaces and directions play a special part. The separation and glide phenomena are ruled by critical normal and shear stresses. The results of tensile measurements, more particularly with aluminium and zinc crystals, show that the glide curve for shear stresses is dependent only slightly on orientation. By means of such curves the strength and extension of crystals of any orientation may be calculated. The condition that the load passes through a maximum and the extension at the same time comes to an end admits of mathematical treatment and allows of the construction of diagrams from which the theoretical strength and extension may be deduced. The experimental values for a number of crystals agree well with the theoretical values, only crystals near a cube diagonal or cube edge exhibiting somewhat greater strengths than those calculated. The measured values of the extension vary considerably, but on the whole the variation with the orientation corresponds with that expected theoretically, although with most crystals the experimental values are appreciably higher than the calculated ones. T. H. P.

816. Crystalline Structure of Carbonates and Nitrates. C. Schaefer, F. Matossi and Florenz Dane. *ZS. f. Phys.* 45. 7–8. *pp.* 493–500, 1927.

In connection with the investigation of the absorption spectra of the carbonates by Schaefer, Bormuth and Matossi, the authors have studied the reflecting power of several carbonates about 7 μ. Their results differ in several particulars from those of Coblentz, the differences being ascribed to water-vapour bands, which falsified the Coblentz measurements. With Iceland spar, perpendicular to the axis, the maximum was distinctly split up into two, and the shape of the curves for magnesite and iron carbonate could be explained by the existence of a double maximum; curves were also obtained for dolomite, strontianite and aragonite. The results are interpreted on the lines of Brester's theory; this author has already explained the doubling of the characteristic vibrations at 7 μ and 14 μ as being due to distortion of the CO_3 group, the triangle with the O atoms at its corners and the C atom at its centre becoming an isosceles triangle. The authors consider the relation of these triangles to one another; in biaxial carbonates observations of the reflection maxima with polarised light indicate that they are arranged in parallel planes, all pointing in the same direction. Huggins arrives at this structure from another point of view. In monoaxial crystals the triangles are in parallel planes, but they point either irregularly in all directions in these planes, or the perpendicular to the base make angles of 30° or 60° with one another. In regular carbonates the CO_3 groups are no longer arranged in parallel planes. Observations on nitrates are explained by supposing that the NO_3 groups form pyramids, with the N atom at one corner and the O atoms at the other corners. The observations are explained by the arrangements and distortions of these pyramids. H. N. A.

817. Tension-Pressure Experiments with Brass Crystals (Bauschinger Effect). G. Sachs and H. Shoji. *ZS. f. Phys.* 45. 11–12. *pp.* 776–796, 1927.

The unsymmetrical character of the tensile strength of brass and its removal by tempering is first dealt with (Bauschinger effect), following which comes an account of the preparation of brass crystals and their behaviour towards tension and pressure. The experimental evidence points to a similar behaviour to that established for a finely crystalline material. The maximum value of the Bauschinger effect is determined and interpretation difficulties are discussed. An appendix deals with some anomalous density alterations. The paper is replete with diagrams and illustrations. H. H. Ho.

818. Lattice Theory and Electrical Conductivity in Crystals. A. Smekal. *ZS. f. Phys.* 45. 11–12. *pp.* 869–877, 1927.

Braunbek has recently attempted to show that the electrolytic conductivity of rock-salt can be calculated satisfactorily from the lattice theory, and that deviations in the crystal from the ideal lattice structure have no essential influence on electrical conduction through it. The author shows that this conclusion is not correct, and that the apparently good agreement with experiment arrived at is only due to arbitrary assumptions in the treatment of the subject. The chief difficulty of the mechanism of ionic change of place required to explain conduction in an ideal crystal is that the ions, when they move, must do so without producing "holes" or condensations in the lattice. Transference simultaneously all along chains of ions reaching from electrode to electrode along the lines of the lattice has been shown by Hevesy to be excluded, and the author shows that the same is true of irregular chains of ions. The relation between the conductivity and the field intensity is shown to be inconsistent with Braunbek's theory. Even if the theory is modified on the lines of that of Frenkel it does not agree with the facts, and the author maintains his view that electrolytic conductivity in crystals depends on loose places and minute pores in the lattice. H. N. A.

819. Lattice Constant of Thallium Iodide. T. Barth. *Zeits. phys. Chem.* 131. *pp.* 105–106, *Dec.*, 1927.

Lunde and Barth, in a paper on mixture crystals, assumed this constant to be 4·176 Å., and concluded from their measurements of mixture crystals of TlBr – TlI that these, in some cases, had a larger lattice constant than TlI. Goldschmidt has recently determined the constant of TlI by comparing it with that of MgO, which is 4·207Å., and finds the value 4·207Å. ± 0·010 for pure TlI. The author has now used rock-salt as the comparison substance and finds for TlI, $a_0 = 4·198$ Å. ± 0·002. The above statement about the lattice constant of mixture crystals of TlBr and TlI is not correct. The new value for TlI confirms the general lattice theory as used by Grimm and Herzfeld; in their equation $r^n = a^n x + b^n(1 - x)$, the best agreement for mixture crystals of TlI – TlBr takes place when $n = 8$. According to the lattice theory this is the value of the exponent to be expected in the case of the halides of the alkali metals. H. N. A.

820. Crystal Structure of Two Intermetallic Compounds. J. B. Friauf. *Am. Chem. Soc., J.* 49. *pp.* 3107–3114, *Dec.*, 1927.

The atomic arrangements in crystals of two of the intermetallic compounds formed by copper, Cu_2Mg and $CuAl_2$, have been determined by Laue, powder and rotation photographs. The least distance between two copper atoms is 2·43 Å., between two Al atoms 2·59 Å.—somewhat less than their values as separate elements. J. E.

821. Structure of Cu_3Sn and Cu_3Sb. W. M. Jones and E. J. Evans. *Phil. Mag.* 4. *pp.* 1302–1311, *Dec.*, 1927.

An examination by the powder photographic method. Both substances have close-packed hexagonal structures with axial ratio 1·57 in each case. The unit cell dimensions are for Cu_3Sn, $a = 2·75$ and $c = 4·32$ Å. and for Cu_3Sb, $a = 2·78$ and $c = 4·37$ Å. The data are insufficient to determine the space group and atomic distribution. Work on Cu_3P is in progress. W. H. Ge.

822. Structure of the Smoke Particles from a Cadmium Arc. H. P. Walmsley. *Phys. Soc., Proc.* 40. *pp.* 7–13; *Disc.*, 31, *Dec.*, 1927.

Using the powder method of X-ray analysis, the particles dispersed in air from a cadmium arc are found to be isometric crystals of cadmium oxide. From X-ray data, a density of 8·16 was obtained for the primary particles in the smokes—the normal density of cadmium oxide. Photometric measurements of the breadth of the lines showed that the primary crystals were of colloidal dimensions, values of $5·8 \times 10^{-6}$ cm. and $4·9 \times 10^{-6}$ cm. being obtained in two cases. On aggregation, the ultramicroscopic crystals are shown to grow along binary axes of symmetry—*i.e.*, they tend to unite on their 110 faces. Photomicrographs of the deposits obtained from cadmium oxide smokes are shown, together with models of aggregates built on these lines. The models give many of the characteristic structures which are observed in the complex particles. Previous measurements on the smoke particles are discussed in the light of these results. Author.

823. Heat-Motions of Atoms in a Rock-Salt Crystal. R. W. James and Elsie M. Firth. *Roy. Soc., Proc.* 117. *pp.* 62–87, *Dec.* 1, 1927.

The ratio of the intensity of the reflection of X-rays at liquid-air temperature to that at room-temperature was measured for a number of spectra. The temperature-factor is of the form exp. $\{- bf(T) \sin^2 \theta/\lambda^2\}$, the exponent being proportional to $\sin^2 \theta/\lambda^2$ or to the square of the order of the spectrum. For corresponding angles of reflection the temperature factor is considerably larger for spectra of the type Cl + Na than for those of the type Cl − Na. The results are compared with the temperature factors deduced by Debye and Waller: up to 500° abs. fairly good agreement occurs with the theory of Waller. The absolute value of the integrated reflection for the (200) spectrum from a rock-salt crystal was re-determined both for molybdenum and rhodium K_a; an estimate of "extinction" is made; atomic scattering factors at various temperatures are estimated. The Fourier analysis is used to determine the distribution of electrons between the (111) planes of the crystal at different temperatures; an estimation is made of the mean amplitudes of the atomic vibrations; about 0·20 Å. at 290° abs. and 0·58 Å. at 900° abs. An approximate check-calculation leads to results of the same order. A. D.

824. Periodic Table of the Structure of Atoms and its Relation to Ion Formation and Valency. A. A. Noyes and A. O. Beckman. *Nat. Acad. Sci., Proc.* 13. *pp.* 737–743, *Nov.* 15, 1927.

With the assistance of I. S. Bowen the authors have compiled a table and a chart which admit also of differentiating the atom configurations, for which the inner quantum number J and the magnetic moment μ are zero, from those in which they have definite values. H. B.

825. Properties of the Hydrogen Molecule in the Fundamental State. Y. Sugiura. *ZS. f. Phys.* 45. 7–8. *pp.* 484–492, 1927.

This paper constitutes an addition to Heitler and London's paper [see Abstract 3046 (1927)] on the reciprocal action of neutral atoms and homopolar unions according to quantum mechanics. By means of the propositions advanced, the work of dissociation, the moment of inertia, and the characteristic oscillation of the hydrogen molecule may be evaluated. In addition, the ionisation potential of the helium atom may be derived by means of the adiabatic consideration of two hydrogen atoms. H. H. Ho.

826. Theory of the Impact Process for Hydrogen. W. Elsasser. *ZS. f. Phys.* 45. 7–8. *pp.* 522–538, 1927.

The probability of transference from one quantum state to another in the case of impact processes is given by the matrix of the energy of perturbation; this can be calculated for the hydrogen atom, and it appears that empirically the probabilities of excitation by collision are qualitatively related in the same way as the corresponding optical probabilities. The two sets of relations are identical in the limiting case of very high velocity colliding particles; a formula is obtained of similar form to the classical braking formula of Bohr. It is shown that a collision analogy to the Compton effect exists. Tables give the values of the active section $\Phi(nl)$ for the excitation of the (n, l) quantum state for different values of a quantity σ_0, which is proportional to the initial value of the impulse of the particle and of the corresponding volts; one table is for $\Phi(1, 0)$ and another for $\Phi(2, 0)$ and $\Phi(2, 1)$. Curves are given for each of these excitations in which ordinates represent the active section and abscissæ the square root of the voltage, and from these a compound curve is constructed for $\Sigma\Phi$; higher excitations than the above can be neglected. This compound curve is of the same general form as the experimental curve for helium, and when Sugiura's observation that the continuous spectrum of hydrogen is about as strong as the discrete is taken into account, and $\Sigma\Phi$ is doubled to allow for this, the two curves come pretty close together. Deals also with resonance excitation, inverse processes or collisions of the second kind, the nick in the curve of the "yield function," which is so characteristic in the Franck diagram of electron collisions, and other phenomena. H. N. A.

827. Diamagnetic Susceptibility of Hydrogen Molecules and of Helium in the New Quantum Mechanics. S. C. Wang. *Nat. Acad. Sci., Proc.* 13. *pp.* 798–800, *Dec.,* 1927.

The author makes use of the function which he has arrived at in a recent paper, following the lines of the Ritz method, which approximates to the solution of the wave equation for the normal hydrogen molecule, and of the equation given by van Vleck for the diamagnetic susceptibility of atoms and molecules, to calculate the molar diamagnetic susceptibility X_M of hydrogen, the value obtained being $- 4\cdot71 \times 10^{-6}$; this is compared with the value $- 3\cdot94 \times 10^{-6}$ observed by Wills and Hector, $- 3\cdot99 \times 10^{-6}$ by Soné and $- 5\cdot1 \times 10^{-6}$ by Lehrer. Similar calculations have been made for the helium atom, using the energy value of helium calculated by Kellner by the Ritz method; $X_M = - 1\cdot53 \times 10^{-6}$, while the measurements of Wills and Hector give $- 1\cdot88 \times 10^{-6}$. The paper concludes with some remarks on the degree of accuracy of the agreement between the energy values found by applying the Ritz method to the approximate ψ functions made use of and the spectroscopic determinations. H. N. A.

828. Orbits and Radiation of Hydrogen Electrons. T. Engset. *Ann. d. Physik,* 84. 7. *pp.* 880–890, *Dec.* 23, 1927.

This is the final paper of the series [see Abstracts 303, 1275, 2463 and 2665 (1927)], and deals with the case in which two electrons have fallen from a distance into their respective orbits, and thence send out waves with frequencies ν_n and ν_m. The effect of these waves upon a third electron is considered, which is moving in a stable orbit about a third nucleus, the distances of which from the common centre of gravity of the nuclei of the first named orbits is large compared with the distance between these two nuclei. The problem is treated on the lines employed by Helmholz in dealing with the similar acoustical problem, and this leads to vibrations in the charge of the third electron, with the combination frequencies $(\nu_n + \nu_n)$ and $(\nu_n - \nu_m)$. The author has looked for evidence of the existence of lines of such frequencies in the hydrogen spectrum, but has only found one case in which such combination frequencies exist. This case may be due to simple coincidence. H. N. A.

829. Configuration of the CO_2 Molecule. K. L. Wolf. *Zeits. phys. Chem.* 131. *pp.* 90–96, *Dec.,* 1927.

The model of the CO_2 molecule might, like that of H_2O, be a triangle or a rod with the C-atom symmetrically or asymmetrically between the two O. The asymmetrical stretched form would not be stable according to Hund [see Abstract 1558 (1925)]. The question may be decided by the measurement of the temperature coefficient of the dielectric constant and of the dispersion in the infra-red. The solid CO_2 seems to be triangular, but that might change on sublimation [see Schaefer and Phillips, Abstract 2837 (1926)]. On the other hand, the approach of the molecular heat at low temperature to 4·96 cal. (of simple two-atomic molecules) favours the rod shape. Of the three absorption bands 4·25, 14·7, 2·72 μ Eucken considers the first to indicate asymmetry. Discussing the intensity relations, the dispersion and the absence of a dipole moment [Zahn, see Abstract 1882 (1926)] the author sums up in favour of the symmetrical rod model. H. B.

830. Relative Intensities of Positive Rays from the Isotopes of Lithium. J. L. Hundley. *Phys. Rev.* 30. *pp.* 864–870, *Dec.*, 1927.

The relative intensities of positive rays from the isotopes of lithium were investigated for various lithium compounds at different temperatures, using Dempster's method of positive-ray analysis. [See Abstract 1244 (1922).] It was found that there is in general a change in the ratio Li_7/Li_6 with temperature, the ratio decreasing at higher temperatures and increasing at lower. An application of Richardson's law shows that the two isotopes have different work functions, Li_6 having a greater work function than Li_7. The ratio b_6/b_7 is constant over wide ranges of temperature for a given lithium compound, but is different for different compounds. AUTHOR.

831. Characteristic Value Problems in Wave Mechanics and Integration by Means of Series. Part I. F. Brouwer. *Ann. d. Physik*, 84. 7. *pp.* 915–920, *Dec.* 23, 1927.

Discusses the second method indicated by Bechert in a recent paper [see Abstract 40 (1928)], in which the differential equation involved is integrated directly by expanding into a series of powers. The method of this expansion and the conditions of convergence of the series are dealt with, and it is shown how the Laplace differential equation can be brought into the form required for expansion. A general solution for this equation is obtained. The relativity theory Kepler motion in the case of hydrogen is dealt with mathematically by this method, and as a first approximation Sommerfeld's formula is arrived at. An exact solution is also obtained. [See next Abstract.] H. N. A.

832. Characteristic Value Problems in Wave Mechanics and Integration by Means of Series. Part II. F. Brouwer. *Ann. d. Physik*, 84. 7. *pp.* 921–929, *Dec.* 23, 1927.

Discusses the transformations which are required in the differential equations met with in wave mechanics to bring them into the form of the equation dealt with in Part I [see preceding Abstract]. Deals further with the Kepler problem and with the Stark Effect. Special transformations are considered, and as an example is taken the harmonic oscillator problem. The question of half and whole quantum numbers is dealt with, and it appears that half quantum numbers occur as a rule, and that whole numbers are only found in consequence of accidental peculiarities in the equation for any problem. Examples of this are given. H. N. A.

833. Symmetry of the Stress-Tensor obtained by Schrödinger's Rule. H. Bateman. *Nat. Acad. Sci., Proc.* 13. *pp.* 771–774, *Nov.* 15, 1927.

A general expression is obtained for a world-function in Euclidean space of three dimensions, such that a symmetrical stress-energy tensor can be derived from it by means of the rule given by Schrödinger [see Abstract 1293 (1927)] suitably modified for the three-dimensional case. W. S. S.

834. Quantum Rotation of the Mercury Atom. R. G. Loyarte. *Phys. Zeits.* 28. *pp.* 904–908, *Dec.* 15, 1927.

Experimental evidence is reviewed showing that there exists for mercury a number of excitation potentials which can be obtained from potentials corresponding to optical lines of known arc series or their terms, by the addition or subtraction of 1·4 volts or a simple multiple of 1·4 volts. The explanation is advanced that there exists a quantised rotation of the atom, a single rotation quantum corresponding to 1·4 volts. A number of optical lines are found which confirm this hypothesis. An estimate is made of the moment of inertia of the mercury atom and from that the value $r = 6\cdot 10^{-11}$ cm. is obtained for the radius. This is compared with the kinetic theory value $r = 10^{-8}$ cm. and a result obtained by Rutherford for thorium, $r = 7\cdot 10^{-12}$ cm. W. S. S.

835. Free Motion in Wave Mechanics. C. G. Darwin. *Roy. Soc., Proc.* 117. *pp.* 258–293, *Dec.* 1, 1927.

Whereas hitherto the wave mechanics has mostly been applied to a study of stationary states, the present mathematical paper deals with its application to cases where there is a progress of events. After a review of principles and a description of the new way in which motion must be regarded, the following problems are discussed: The free motion of an election under no forces; the motions of an electron in uniform electric and magnetic fields; the motion of an electron in an atom; the motion of an atom in a uniform magnetic field; the Stern-Gerlach effect; the motion of the spinning electron. H. H. Ho.

836. Zeeman Effect of the Symmetrical Top according to Wave Mechanics. E. U. Condon. *Phys. Rev.* 30. *pp.* 781–784, *Dec.*, 1927.

The molecular model consisting of a rigid rotator with two different moments of inertia (symmetrical top) has been investigated by wave mechanics, when unperturbed and in the presence of an electric field [see Abstract 1620 (1927)], and the present paper considers the effect of a magnetic field on the energy levels. The wave equation is derived by the aid of a variation principle due to Fock [see Abstract 2536 (1926)] and leads simply to an expression for the change in the eigen energies due to the magnetic field; the alteration is found to be small compared with the Zeeman effect for atoms, the magnitudes of the two effects being in the ratio of electronic to nuclear mass. W. S. S.

837. Note on the Approximate Validity of Classical Mechanics in Quantum Mechanics. P. Ehrenfest. *ZS. f. Phys.* 45. 7–8. *pp.* 455–457, 1927.

For the motion of a particle of mass m in one dimension x under the action of a potential field $V(x)$, Schrödinger's equation can be written $-\frac{h^2}{2m}\frac{\partial^2\psi}{\partial x^2} + V(x)\psi = ih\frac{\partial\psi}{\partial t}$. It is shown that the following relation holds exactly

$$m\frac{\partial^2}{\partial t^2}\int_{-\infty}^{+\infty}\psi\bar{\psi}x\,dx = \int_{-\infty}^{+\infty}\psi\bar{\psi}\left(-\frac{\partial V}{\partial x}\right)dx.$$

If the extension of the wave packet is small this equation takes the Newtonian form $m\frac{\partial^2 X}{\partial t^2} = -\left.\frac{\partial V}{\partial x}\right|_X$, where X is the coordinate of the "mass-centre" of the wave packet. A numerical calculation of the rate of dispersal of a wave packet is also included. W. S. S.

838. Problem of Several Bodies in the Quantum Theory. P. Jordon and O. Klein. *ZS. f. Phys.* 45. 11–12, *pp.* 751–765, 1927.

By a similar process to that employed by Dirac [see Abstract 2042 (1927)], the present authors have derived the symmetrical solution of the wave equation in spatial coordinates for a number of electric particles taking into account their mutual effects by a quantification of the de Broglie waves in three-dimensional space. H. H. Ho.

839. Waves and Corpuscles in Quantum Mechanics. P. Jordan. *ZS. f. Phys.* 45. 11–12. *pp.* 766–775, 1927.

Dirac has shown [see Abstracts 294 and 2042 (1927)] how the Bose-Einstein statistics of an ideal gas may be described by means of *q* numbers for a number of atoms with characteristic energies. The number of these atoms can be generalised, and the present paper discusses the mathematical and physical relationships between the different quantities involved and their significance in the problem of spatial density fluctuations. H. H. Ho.

840. Quantum Mechanics and Theory of Groups. H. Weyl. *ZS. f. Phys.* 46. 1–2. *pp.* 1–46, 1927.

The author investigates a mathematical formulation of the underlying principles of quantum mechanics. Part I.—An aggregate of atoms is said to correspond to a "pure" case when it possesses the highest possible degree of homogeneity. A pure case is specified by means of a vector X with complex components $x_1\ x_2\ .\ .\ .\ x_n$, and of absolute value unity. All physical quantities associated with the aggregate are represented by Hermitean forms $A(X) = \sum_{i,k=1}^{n} a_{ik}x_i\bar{x}_k$. The form for a given physical quantity, by a suitable coordinate transformation can be referred to its principal axes so that $A(X) = a_1x_1\bar{x}_1 + a_2x_2\bar{x}_2 + \ .\ .\ .\ + a_nx_n\bar{x}_n$. The numbers a_i are all the values which the quantity can assume and $|x_1|^2$, $|x_2|^2$, etc., are the relative probabilities with which these values arise in the pure case X. Most actual cases correspond to compositions of different pure cases in different amounts, the resultant probabilities then being obtained by weighted addition. Part II.—The theory of groups of orthogonal transformations in the space of the x's is developed. It is shown that corresponding to two Hermitean matrices, P and Q, which satisfy $i(PQ - QP) = 1$, a continuous Abelian group of transformations is generated having the matrices $\exp.\ i(P\sigma + Q\tau)$, where σ and τ are real variables. From any function $\xi(\sigma, \tau)$ for which $\xi(\sigma, \tau) = \xi(-\sigma, -\tau)$, a matrix $F = \iint_{-\infty}^{+\infty} \exp.\ i(P\sigma + Q\tau)\ .\ \xi(\sigma, \tau)d\sigma d\tau$ can be derived. P and Q are now identified with the canonical variables of a system with one degree of freedom and the matrix of the Hermitean form corresponding to any physical quantity which on classical theory is given as a function $f(p, q)$ of the classical canonical variables, is on the present theory the matrix F above, with $\xi(\sigma, \tau)$ so chosen that

$$f(p, q) = \iint_{-\infty}^{+\infty} \exp.\ i(p\sigma + q\tau)\ .\ \xi(\sigma, \tau)d\sigma d\tau.$$

Part III.—The behaviour of a system corresponding to a pure case X is completely determined by the dynamical law $\frac{dx_h}{dt} = \frac{2\pi i}{h}\sum_i e_{ih}x_i$, where $\|e_{ih}\|$ is the matrix of the Hermitean form of the energy. If the axes are principal axes for the energy matrix, then the coefficients in any other Hermitean form vary periodically with the time according to the Bohr frequencies. The relation of the present theory to Schrödinger's wave theory is indicated. W. S. S.

841. Perturbation Energy and Cross-Switching in the Many Body Problem. W. Heitler. *ZS. f. Phys.* 46. 1–2. *pp.* 47–72, 1927.

The first part of this paper is a restatement of Wigner's theory of non-combining term systems. The corresponding energy values are then investigated, using the methods of the theory of groups. In the second part the physical implications of the results are discussed, the most important being that the term multiplicity of a system of electrons is not raised by the presence of an inner closed shell of electrons. W. S. S.

842. The Quantum Theory of Homopolar Valency Numbers. F. London. *ZS. f. Phys.* 46. 7–8. *pp.* 455–477, 1928.

As in the case of hydrogen, there are two components to consider in calculating the energy of reciprocal action of two neutral atoms, the Coulomb reciprocal action between the spatial "charge clouds" of the single atoms, attraction, and the so-called energies of exchange, which may give attraction or repulsion according to the character of the symmetry of the characteristic vibration excited in the configuration space. Without spin of the electrons the Pauli principle would only permit of the antisymmetrical solution, with repulsion, and there could be no homopolar combinations. The electrons of the inner closed shells of an atom have nothing to do with valency, since the coordinates of their centres of gravity are symmetrically united within the characteristic functions of the single atoms, and on account of the Pauli principle the pairs must have antiparallel spin which must be antisymmetrical. The following table shows the different arrangements proposed for the outer electrons of the halogens in "terms" which all have the same principal quantum number n, and which are regarded as concerned in chemical combination:—

Quantum No. l	0		1				2			Valency
Quantum No. m_l	0	−1	0	1	−2	−1	0	1	2	
Number of electrons	2	2	2	1						1
	2	2	1	2						
	2	1	2	2						
	2	2	1	1	1	–	–	–	–	3
	2	1	1	1	1	1	–	–	–	5
	1	1	1	1	1	1	1	–	–	7

It will be seen that the number of single electrons in a horizontal row is equal to the valency. The pairs are coupled like those in the interior shells and do not affect the valency in any way, while the single electrons produce the chemical attractions, and are to be regarded as valency electrons. Other positions are, of course, possible for the electrons in the fourth column of the table. The author deals in a similar manner with the elements in the row of the periodic table headed by oxygen and with those in that headed by nitrogen. The original paper contains many other interesting deductions and should be consulted. H. N. A.

843. Gauge-Invariant Gravitational Equations. E. Reichenbächer. *ZS. f. Phys.* 45. 9–10. *pp.* 663–688, 1927.

The field equations are developed which arise by the introduction into the Hamiltonian action integral, of the scalar Riemannian curvature or the square root of the determinant of the corresponding tensor, or of gauge-invariant extensions of these. In all cases the equations obtained can be reduced to the form: $G_{\mu\nu} = \lambda g_{\mu\nu}$. W. S. S.

844. A Construction giving the Mass of a Charged Material Point in the Universe of Five Dimensions. A. Schidlof. *Comptes Rendus*, 185. *pp.* 1262–1263, *Dec.* 5, 1927.

If $d\sigma$ denotes the invariant element of the universal line of the material point, and $d\delta$ and dl represent two infinitesimal vectors, the former of which is oriented according to the invariant direction of the fifth dimension, the latter being perpendicular to it, then an interpretation of the equation $d\sigma^2 = ad\delta^2 + bd\delta ds + cds^2$ may be made by a construction in the plane of the vectors $d\delta$ and dl. The universal impulse vector of the material point has a magnitude independent of the sign of the electric charge; that of the proton forms an angle x (of the order of 10^{-18}) and that of the electron an angle $\pi - x$ with the direction $d\delta$. If an axis inclined to $d\delta$ be drawn at a negative angle β a little less than x, and if at the extremities of the two impulse vectors lines be drawn parallel to this axis, then by a suitable choice of the ratio of x and β the components along dl will be given for the proton and electron. H. H. Ho.

845. Five-Dimensional Representation of the Theory of Relativity. O. Klein. *ZS. f. Phys.* 46. 3–4. *pp.* 188–208, 1927.

The fifth dimension of the author's five-dimensional relativity theory is conceived as an electric charge contemplated in accordance with the quantum theory, and its non-observability is associated with the existence of the elementary electric quantum. Relativity theory, more especially the portion dealing with the five laws of the conservation of impulse, energy, and quantity of electricity, is developed in terms of the five-dimensional Riemannian geometry due to Kaluza. J. S. G. T.

846. Signal and Counter-Signal with Velocity exceeding that of Light, in the Special Theory of Relativity. J. Würschmidt. *Phys. Zeits.* 28. *pp.* 809–812, *Dec.* 1, 1927.

The author discusses the proposition relating to a signal and counter-signal propagated with a velocity exceeding that of light, due to Thirring and considered by Bass [see Abstract 1257 (1926)], and concludes that the proposition does not conflict with freedom of will. J. S. G. T.

847. Principle of the Limitation of Velocities. R. Bass. *ZS. f. Phys.* 46. 3–4. *pp.* 305–306, 1927.

The significance of velocities exceeding that of light, in the special theory of relativity, is briefly discussed. J. S. G. T.

METEOROLOGY AND GEOPHYSICS.

848. Past Climates. G. C. Simpson. *Roy. Meteorolog. Soc., J.* 53. *pp.* 213–225; *Disc.*, 225–232, *July*, 1927.

Changes in extent and distribution of land masses or ocean currents could not have produced larger variations of temperature than are to be found in the northern hemisphere to-day. The zonal distribution of temperature cannot be changed—there must always have been a cold polar zone, a warm tropical zone and an intermediate temperate zone, all very similar to those existing to-day. Greenland conditions show that an ice-sheet could not have extended from the Scandinavian plateau to cover the area which was ice during the last Ice Age. Discussion of present conditions in tropical regions shows that ice could never have reached sea-level within the tropics. Meteorology is unable to offer a solution to the problems of past climates, and the suggestion of Wegner that the cause lay in continental drifting must be left to geologists.

W. A. R.

849. Dune-Structures. V. Cornish. *Roy. Astron. Soc., M.N. Geophys. Suppt.* 1. *pp.* 447-467, *July*, 1927.

The paper treats of ripples, dunes and dune-like structures formed by wind or under water. Numerous observations and measurements are given illustrating the author's thesis that all are surface waves, formed in granular material by wind or water currents. W. A. R.

850. Oceanic Tides on a Non-Rotating Earth. J. Proudman and A. T. Doodson. *Roy. Astron. Soc., M.N. Geophys. Suppt.* 1. *pp.* 468–483, July, 1927.

Equations of oceanic tides have previously been solved only when the ocean covers the whole earth or is bounded by two parallels. In the present paper an ocean bounded by two meridians on a spherical earth with uniform depth of ocean is analysed; the dynamical effects of the earth's rotation and the gravitational attraction of the elevated water are neglected. Diagrams of the resulting co-tidal lines are given. W. A. R.

851. The Jersey and Hereford Earthquakes, 1926. H. Jeffreys. *Roy. Astron. Soc., M.N. Geophys. Suppt.* 1. *pp.* 483–494, July, 1927.

The existence of the main waves found by continental investigators of near earthquakes is confirmed. The velocities are as follows: P, 7·8; P^*, 6·3; P*g*, 5·4; S, 4·35; S^*, 3·7; S*g*, 3·3 km./sec. There is no detected difference between Great Britain, the North Sea, the Channel, and the Continent. The depth of the granite layer is about 10 km., and that of the intermediate one 20 km. The foci were about 10 km. for the Jersey and 8 km. for the Hereford shock. The amplitudes of the first movements of P*g* and S*g* are roughly proportional to the inverse distance. The energy of the Jersey earthquake was of the order of 10^{19} ergs and that of the Hereford 5×10^{16} ergs.

Instruments.—The investigation enabled a comparison of different types of instrument to be made. The Milne-Shaw machine is not quite so good as the Wiechert, but both are definitely preferable to the Galitzin.

W. A. R.

852. Seismic Waves in Surface Layers. P. Byerly. *Nat. Research Council, Bull.* 61. *pp.* 88–90, *July*, 1927.

Californian earthquakes are treated on lines similar to those of Jeffreys [see preceding Abstract], but the records are insufficient to draw definite conclusions. There are a number of marked new arrivals. The apparent surface-velocities of some of these groups are the same as those of certain surface waves for distant quakes. W. A. R.

853. Elastic Waves in Stratified Bodies. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 3. *pp.* 1–18, *Sept.*, 1927. *In English.*

Consideration is given to the dispersion of elastic waves (1) on a solid stratified body and (2) to the waves propagated over a curved surface. The velocity of surface waves in both cases depends on their wave-lengths. The energy of short-length waves accumulates on the surface of a body, and this fact may have important bearings on the relation between surface and non-surface seismic waves and also on the problem of the vibration of constructive materials. W. A. R.

854. Scattering of Elastic Waves. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 3. *pp.* 19–41, *Sept.*, 1927. *In English.*

Whatever the nature of the incident wave, the scattering waves are composed of both dilational and distortional waves. In front of a hollow cavity vibrations are nearly of standing type, and in the rear part appears a space practically quiescent. These phenomena are absent if the obstacle is small compared with the wave-length. Motions of imbedded particles influence inertia masses for a certain range of wave-lengths. The vibration of the restitutive origin itself decays by emitting elastic waves. The decay factor depends on density relative to the surrounding medium, the size, shape, and velocities of waves in the surrounding medium. W. A. R.

855. Waves in Visco-Elastic Bodies. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 3. *pp.* 43–53, *Sept.*, 1927. *In English.*

Simple cases concerning the nature of solid viscosity and its effects on waves have been considered [see Abstract 51 (1924)]. Pulses in visco-elastic solid bodies take gradually flat forms, their apparent wave-length being prolonged. Equations of free waves in elastic bodies enable the problem of forced vibrations of constructive materials to be solved. The equation of pulses in visco-elastic solid bodies enables "shock" to be analysed mathematically. W. A. R.

ASTROPHYSICS.

856. Some Recent Advances in Astrophysics. E. A. Milne. *Manchester Phil. Soc., Mem.* 71. *pp.* 1–6, 1926–1927.

The sun's effective temperature can be measured by the total radiation leaving each square centimetre of its surface, or by the ratio of the intensities of radiation for two different constituents of its spectrum (that is, by its colour); for stars, colour-type measurement is only possible, but by Planck's law this yields the first measure which is also the amount generated in the interior per second, assuming a quasi-steady state. The author gives two examples of its employment: the determination of a star's angular diameter as seen from the earth, and the estimate of the densities of binary components. The star's effective temperature is not that of any particular region, but the actual temperature near the surface can be found from the absorption spectrum produced by the atoms volatilised in the star's atmosphere. He describes Saha's theory, and points out that at the highest temperatures the neutral atom disappears completely, and the absence of an element may only mean that the lines it can produce are outside the accessible range of spectrums. He distinguishes the ultimate lines of an atom in any given stage of ionisation from the remaining lines, and shows from Miss Payne's work that these ultimate lines give the relative abundances of elements in stellar atmospheres as roughly that in the earth's crust (except hydrogen and helium). He refers to Ch'ing-Sung Yü's work on the limits of Balmer's series of hydrogen. [See Abstracts 1780 (1926) and 942 (1927).] A. S. D. M.

857. Corona Observations. H. T. Stetson, W. W. Coblentz, W. Arnold and W. A. Spurr. *Astrophys. J.* 66. *pp.* 65–88, *Sept.*, 1927.

Photometric measurements of the corona at the eclipse of January 14, 1926, are described. The Macbeth illuminometer gave the value for the total minimum illumination received from the corona and sky as 0·0128 metre-candle. Photographic estimations lead to values within a 3° circle, photographic magnitude − 11·38, photovisual magnitude − 12·00 and colour index + 0·65. A. Wh.

858. Solar Rotation and the Einstein Displacement derived from Measures of the H and K Lines in Prominences. J. Evershed. *Roy. Astron. Soc., M.N.* 88. *pp.* 126–134, Dec., 1927.

The results given are derived from observations taken at Ewhurst, the spectroheliograph and the technique being described in some detail. Results obtained at Kodaikanal are also discussed. It is assumed that the rapid movements of prominences are distributed at random, no systematic component in the direction parallel with that of the line of sight being present. Tables are given showing the mean sidereal velocity, which is about 1 km./sec. in excess of the velocity in the reversing layer, and the distribution of this velocity over different latitudes. There is an apparent polar retardation. The general relativity shift is also derived and is found to be 0·0109 Å. from the H and K lines compared with 0·0110 Å. from Kodaikanal observations and 0·0116 Å. from the iron lines in the reversing layer. The calculated value is 0·0081 Å., the error being larger than can be accounted for by errors of observations. A. Wh.

859. Integral Equation of Radiative Equilibrium and its Generalised Form. U. Wegner. *ZS. f. Phys.* 45. 11–12. *pp.* 808–828, 1927.

The author develops the integral equation of radiative equilibrium,

$$B(\tau) = \tfrac{1}{2}\int_{0}^{\infty} B(t)\,\mathrm{L}i(e^{-|t-\tau|})\,dt,$$

and its more generalised form,

$$B(\tau) = \lambda\int_{-\infty}^{+\infty} B(t)\,\mathrm{L}i(e^{-|t-\tau|})\,dt,$$

and shows in the latter case the only possible solution, $B(t) \equiv 0$, is integrable; in the former case the only solution, which is ≥ 0, is $B(t) \equiv 0$, in the case that $B(\tau)$ is limited. [See also Abstracts 1397 (1921) and 1686 (1927).] A. S. D. M.

860. Integral Equation of Radiative Equilibrium and its Generalised Form. U. Wegner. *ZS. f. Phys.* **45. 11–12.** ***pp.*** **829–846, 1927.**

The integral equation $B(\tau) = \lambda\int_0^\infty B(t)Li(e^{-|t-\tau|})dt$ with any λ is discussed, and further theorems concerning its solution are deduced. In his work under the same title [see preceding Abstract] the author demonstrated some theorems concerning the existence or otherwise of solutions subject to certain assumptions. The investigation is here continued. E. F.

861. Integral Equation for Radiative Equilibrium. E. Freundlich, E. Hopf and U. Wegner. *Roy. Astron. Soc., M.N.* **88.** ***pp.*** **139–142,** ***Dec.,*** **1927.**

The integral equation of radiative equilibrium is

$$B(\tau) - \tfrac{1}{2}\int_0^\infty B(t)Li(e^{-|\tau-t|})dt = 0,$$

and various authors have attempted to show that the only solution is $B(\tau) = 0$. Kostitzyn has shown that the equation $B(\tau) = \int_8^H B(t)Li(e^{-|\tau-t|})dt$ gives only the solution $B(\tau) \equiv 0$ when H is arbitrarily great, and so argues that as $H \to \infty$ the integral equation for radiative equilibrium must give a solution identically equal to zero. It is shown that Kostitzyn's result depends on an erroneous passage to the limit. Ambarzumian and Kosirev arrive at the same conclusion as Kostitzyn, but at one stage of their argument assume that the integral $\int_0^\infty B(\tau)\psi_1(\tau)d\tau$ vanishes for every solution $B(\tau)$. Actually the integral $\int_0^\infty \phi(\tau)B(\tau)d\tau$ does not exist in general, and the validity of the argument fails. It is considered as established that solutions of the integral equation exist. A. Wh.

862. Ultra-Violet and Lyman Radiation from the Sun. Z. A. Merfield. *Roy. Soc. Victoria, Proc.* **39. 2.** ***pp.*** **56–58, 1927.**

From observations of the heights attained by calcium and barium ions it is concluded that the pressure of radiation in the far ultra-violet region is low. The bright line emission in these regions is also unlikely to account for the ionisation of the upper atmosphere, and it is considered that the hypotheses of penetrating radiation or of high-velocity charged particles are both preferable. A. Wh.

863. Unsöld's Theory of the Chromosphere. W. Anderson. *ZS. f. Phys.* **46. 5–6.** ***pp.*** **445–448, 1927.**

According to Unsöld, the pressure in the chromosphere is about 17×10^{-8} atm. To get the correct intensity of the Ca lines there must be $4{\cdot}51 \times 10^{19}$ C^+ atoms per sq. cm. of solar surface, which leads to a pressure of 5×10^{-8} atm., and agrees with the above estimate quite well. On the other hand, Fowler and Milne, assuming a breadth of 10 Å. for the K line, find that at most $2{\cdot}4 \times 10^{-8}$ gm. cm.$^{-2}$ can be held up by selective radiation pressure, which leads to a pressure of about 5×10^{-13} atm. in the chromosphere, and even this is regarded by them as an over-estimate. Unsöld's number of atoms could not be held up in this way. Difficulties with Milne's theory are also pointed out. In particular the author calculates the pressure of the electrons in the lower part of the corona as $1 \cdot 05 \times 10^{-11}$ atm., and the partial pressure of the electrons in the upper part of the chromosphere can hardly be less than 10^{-11} atm., while Milne's theory requires about 10^{-13} atm., or even less. Schuster's hypothesis is helpful; this assumes that the partial pressure of the electron gas in the upper chromosphere is more than 100 times that of all the other gases. This would tend to check the formation of Ca^{++}. The difficulty here is with the space charge and the large electrostatic field which would appear to make equilibrium in the chromosphere impossible. The author suggests that in the chromosphere a phenomenon similar to the Ramsauer effect may exist, so that the enormous field may have little if any action on slow electrons; a similar hypothesis has been put forward in connection with the corona. H. N. A.

864. Asymptotic Orbits near the Equilibrium Point in the Isosceles Triangle Solution of the Problem of Three Bodies. W. H. Gage. *Roy. Soc. Canada, Trans.* 21. *Sect.* 3. *pp.* 377–390, *May*, 1927.

Two finite spheres of equal mass revolve in circles or ellipses about one another. A satellite of infinitesimal mass can describe an orbit which is a straight line passing through the centre of mass and at right angles to the line joining the centres. This paper, which is entirely mathematical, discusses the orbits which are asymptotic to this orbit when the masses move in ellipses. A. Wh.

865. Figure of Equilibrium of a Rotating Fluid Mass. R. Wavre. *Comptes Rendus*, 185. *pp.* 1113–1115, *Nov.* 21, 1927.

A theorem of Stokes stated that the potential outside a rotating mass having a single angular velocity is of the form $U = F[S, \omega, M]$. It is proved that the theorem can be applied to cases where the angular velocity is a function of the distance from the axis, being written $U = F[S, \omega(l), M]$. A. Wh.

866. Perturbations of the Major Axis of a Satellite or Planet. L. Becker. *Roy. Astron. Soc., M.N.* 88. *pp.* 88–93, *Nov.*, 1927.

A mathematical treatment of the integration of the equation for the major axis of the orbit of a satellite disturbed by the sun or of a planet disturbed by another planet. A. Wh.

867. Forbidden Lines in the Spectra of Nebulæ. A. S. Eddington. *Roy. Astron. Soc., M.N.* 88. *pp.* 134–138, *Dec.*, 1927.

Bowen pointed out that the occurrence of forbidden lines in the spectra of nebulæ depend on the fact that the mean free path is so great that there is only a small probability of an atom having a collision during the period in which it is in a metastable state. Woltjer has considered that this theory does not give a fully satisfactory explanation, but the author shows that it can be made sufficient if it is postulated that the stimulating radiation must be so weak that the atom is unlikely to absorb a quantum during the period in which it is in a metastable state. A. Wh.

868. Spectrum of Halley's Comet. N. T. Bobrovnikoff. *Astrophys. J.* 66. *pp.* 145–169, *Oct.*, 1927.

A study of 53 spectral plates by J. A. Parkhurst, three by O. J. Lee, and direct photographs by E. E. Barnard. The author describes the instruments and methods for discriminating between the comet image and plate fogging, etc. The dimensions and variations of the direct images are consistent with, but much greater than, the spectral. A table is given of the sizes of the head, both direct and on the bands CNN, C + H, and CIV, from Dec. 18 to June 26; a halo was visible from May 24 to June 7, varying in size and brightness, sometimes obliterating the details of the envelopes sometimes faint in comparison, and in shape a perfect sphere with nucleus as centre and possibly connected with the violent changes of May 23–24. All spectral and direct head images diminished with approach to perihelion with a minimum a month after perihelion. Reflected sunlight constituted much of the total light of the head near perihelion (the solar type with maximum at λ4700), and the comet's intrinsic light favours the violet side of the spectrum (maximum intensity at λ4000). Probably the fading out of the violet-type continuous spectrum near perihelion was apparent only, being faint as compared with the solar type. The author notes that many phenomena are probably connected with the internal structure of Halley's comet and repeat themselves at various apparitions. He cites cases from the appearances of 1682, 1759 and 1835–36. A. S. D. M.

869. Spectra of Comets. N. T. Bobrovnikoff. *Astrophys. J.* 66. *pp.* 439–464, *Dec.*, 1927.

The spectra of twenty-two comets which were obtained during the period from 1908 to 1927 at the Yerkes Observatory, with the Zeiss 6-in. ultraviolet camera and objective prisms, have now been studied photometrically. A self-registering microphotometer with a thermopile was used for this purpose. The spectrum of comet 1927 *d* (Stearns) was observed visually at a heliocentric distance 3·7 astronomical units. Evidence for existence in the comets of two distinct types of continuous spectrum is obtained. One spectrum has its maximum of intensity near λ4700 and has been called the "solar-type spectrum." The other, with its maximum at about λ4000, has been called the "violet-type spectrum." A correlation between the heliocentric distance of the comet and the type of the continuous spectrum is established. At $r < 0 \cdot 7$ astronomical units the solar spectrum is usually predominant; at $r > 0 \cdot 7$, the violet. No definite correlation between the type of the spectrum and the phase-angle of the comet is found. Sudden changes in the spectrum of the comets are studied, especially in comet Delavan (1914 V). Similar changes in the spectrum of Halley's comet have been described in a previous publication. The spectrum of different parts of the comet is isolated and compared with direct photographs. Two cases of contradiction to Bredichin's theory of cometary forms are found—comets Delavan and Gale (1912 II) had the same spectrum for both tails. Reasons are given in favour of the fluorescent origin of the cometary spectrum. AUTHOR.

870. Radial Velocity and Spectrum of Cepheid Variable, T. Monocerotis. R. F. Sanford. *Mt. Wilson Observat., Contrib. No.* 340. *Astrophys. J.* 66. *pp.* 170–183, Oct., 1927.

The author describes the discovery and history of this Cepheid whose period is one of the longest known, and discusses the question of its lengthening, adopting Bemporad's modified formula: Max = J.D. 2410012 . 1956 + 27·003131 E + 0·000025221 E^2, G.M.T. He collects fifty values of the radial velocity between dates 1905 and 1927, and uses the above formula to group them. He gives diagrams of this radial-velocity curve and of Wendell's light curve, and infers that the former is normal when compared with other Cepheids of shorter periods. The radial-velocity curve can be resolved into two typical radial-velocity curves having a period equal to the photometric period. He derives velocity curves also from lines of (1) high, (2) low atmospheric level, and (3) the γ line of hydrogen; the three curves do not show a steady progression in amplitude with increase of level, and the H_γ curve seems to lag after maximum velocity as if its part of the stellar atmosphere continued its most rapid approach to a later phase. There is a small change in spectral type and in the relative intensity of enhanced lines to arc lines; and a definite change in effective wave-length with phase, so that the star is decidedly bluest at maximum light. From about eight days after maximum to the phase of minimum light the star changes little in colour.

A. S. D. M.

871. Statistical Study of the Effect of the Mass-Luminosity Relation on the Hypothetical Parallaxes of Binary Stars. R. O. Redman. *Roy. Astron. Soc., M.N.* 88, *pp.* 33–51, Nov., 1927.

Some years ago Jackson and Turner published a study of the hypothetical parallaxes of some hundreds of binary stars. It is here sought to improve upon this by making the components of each star obey Eddington's mass-luminosity relation instead of adopting a standard mass for each star. The procedure is to determine by trial and error a parallax such that the mass and luminosity resulting from it conform to the mass-luminosity relation. The results are given in a " Russell diagram " containing absolute magnitude and spectral types for 803 stars (bright components only). From this the course of the central line of the main series should be found with considerable accuracy. Further, a measure of the scatter from the central line is found. The apparent scatter arises from three sources: (1) true scatter; (2) inaccuracy of observational data; (3) varying inclination which for non-orbit stars is unknown and replaced by an average value in the formulæ. The third scatter is calculated theoretically in order to estimate how much can be attributed to (1) and (2). For stars of known proper motion these parallaxes enable us to calculate the solar motion and mean peculiar motion for stars of each type. For dwarfs the results agree with those usually accepted, but for giants they are difficult to explain. In the case of non-orbit stars the most probable value of the parallax does not correspond to that of the absolute magnitude, a different kind of averaging of the inclination factors being required. This point is investigated theoretically, and it is found that with the formulæ used the resulting mean absolute magnitude (of stars of any spectral type) requires a correction of about $-0^{m}\cdot3$, but the mean linear velocity requires very little correction. The paper contains numerous figures and is mainly mathematical.

E. F.

LIGHT.

872. Range of Colour Excitation Measurement. R. Luther. *Zeitschr. f. tech. Phys.* 8. 12. *pp.* 540–558, 1927. *Paper read before the Deut. Physikertag, Kissingen, Dec.*, 1927.

The first part of the paper deals with the building up of the classical laws of colour, and it is shown that with the three-standard excitation it was easier to deal with the mixed excitation by combination of those from the red, green and blue. A new quantity " colour moment " is derived from Newtonian considerations of the centre of gravity of combined colour excitations, and it is used to illustrate the relations between the three- and four-colour systems. It is further used to re-establish the three important three-dimensional colour bodies which are of especial use for the production of the chromatic properties of pigment colours. These are (*a*) Grassman-Helmholtz body (coordinates colour tone, saturation and brightness), which allows the " optimum " colour to be given besides the section of the spectrum; (*b*) optimum colour spiral (coordinates blue-yellow, green-red and brightness), and (*c*) pigment colour excitation body (Hering-Maxwell) with the same coordinates. This is used to show the deficiencies of the Ostwald three-colour system. In the second part questions regarding the technique of colour measurement, heterochrome photometry and of three-colour photometry are reviewed. R. S. R.

873. Theory of Electric and Magnetic Birefringence in Liquids. C. V. Raman and K. S. Krishnan. *Roy. Soc., Proc.* 117. *pp.* 1–11, *Dec.* 1, 1927.

The double refraction exhibited by liquids when placed in an electrostatic field is ascribed in the theory of Langevin [*Le Radium*, 9. *p.* 249 (1910)] to an orientation of the molecules produced by the field, the orientative couple arising from an assumed anisotropy of the molecule. Born [see Abstract 934 (1918)] modified the Langevin theory by including also the orientative effect of the field on the molecule due to the permanent electric moment, if any, possessed by it. In the present paper a new theory is put forward, which may be regarded as a modification of the Langevin-Born theory. It is assumed in the latter theory that, while the molecules themselves are anisotropic, their distribution round any particular molecule in the medium can be considered as being spherically symmetrical with respect to it. This assumption can hardly be correct in any actual liquid, so that the local polarisation of field acting on any molecule must depend on its orientation. The proposed modification of the theory takes this anisotropy of the polarisation field also into account. The modified expression for the birefringence is in better accord with facts than the Langevin-Born expression. As a rule the effect of the anisotropy of the polarisation field is to diminish the magnitude of the birefringence to be expected. This is explicable as due to the fact that, in general, the larger linear dimension of a molecule tends to be also the direction of maximum electrical and optical susceptibility. The distribution of the molecules in a dense fluid therefore tends to be such that their mutual influence is equivalent to an apparent diminution in the anisotropy of the molecules. A. B. W.

374. A Doubtful Point of the Abbé Theory of Optical Illustrations. V. Ronchi. *ZS. f. Phys.* 46. 7–8. *pp.* 594–603, 1928.

In the theory of images of objects which are not self-luminous one accepts that the image produced is exactly in the plane of that obtained if the object were self-luminous. The author deals with the theory of the method, and shows that the condenser does not act in this way. In a detailed discussion of the phenomenon it is proved that the image of an object not self-luminous does not take place according to the Abbé theory. R. S. R.

875. Systems of Dispersion Prisms with Constant Deviation. A. Biot. *Ann. Soc. Sci. de Bruxelles*, 47. *pp.* 136–143, *Dec.*, 1927.

The author extends the case previously considered for a single prism to that for a series of prisms. The theory of the method is given in detail and the conditions which need to be satisfied. He shows that all systems of dispersion prisms which are entirely symmetrical, and some systems symmetrical only for angles or indices of refraction, by the use of a plane reflecting surface placed inside or outside the system, can be transformed into a system of constant deviation for identical external faces. Further, all systems of constant deviation possess a point of Uhler such that rotation around this point causes all rays travelling along the axis of the collimator to travel along the axis of the telescope. This point can be found easily, and the best position for it is discussed. R. S. R.

876. Method for Comparing the Times of Mixing of Two Transparent Liquids in Different Proportions. L. E. Dodd. *J. Phys. Chem.* 31. *pp.* 1761–1789, *Dec.*, 1927.

A method of measuring the time of mixing of two or more transparent liquids, not too readily miscible, making use of the aberrational effect of the striæ upon a beam of transmitted light, has been worked out and tested experimentally. It was found that the striæ disappeared quite abruptly, and that this rendered it possible to define and determine the time of the end of the mixing. Gasoline and CS_2 mixed in proportions by volume of 0·8 % to 98·8 % gave times of mixing varying with the percentage of 18 seconds to 6·5 minutes. The results were reproducible to a fair degree of accuracy for a series of eighteen readings; the average mean deviation values were 6·3 % and 5·0 % respectively, and the extreme deviation values were 17·0 % and 13·0 %. F. J. B.

877. Reflection, Dispersion and Absorption of Calcspar in the Absorption Region at 7 μ. F. Matossi and Florenz Dane. *ZS. f. Phys.* 45. 7–8. *pp.* 501–507, 1927.

Measurements of the reflecting power of calcspar for different crystallographic surfaces and for wave-lengths from 6·2 to 7·2 μ have been carried out and the observation of J. Koch [see Abstract 299 (1912)] that the variation of reflecting power with wave-length is different for different surfaces has been confirmed. The Drude theory of reflection at absorbing crystal surfaces is employed to calculate the refractive index and absorption coefficient for different wave-lengths of the range worked with. Despite considerable discrepancies between the calculated and observed reflecting powers for one crystal surface, the results are generally in accordance with Drude's theory. W. S. S.

878. Refraction and Dispersion of Air, Oxygen and Gaseous Chloroform, and New Determinations of the Gaseous Refractivities of Acetone, Methyl Ether and Ethyl Ether. H. Lowery. *Phys. Soc., Proc.* 40. *pp.* 23–28, *Dec.*, 1927.

The refractivities of air, oxygen and gaseous chloroform have been found for the green mercury line (λ5461) and the dispersion studied over the range λ4800 to λ6700, with the following results:—

Air: $$(\mu - 1)_{n.t.p.} \times 10^{7} = 2931(\lambda 5461)$$

$$(\mu - 1)_{n.t.p.} = \frac{4\cdot 8286 \times 10^{27}}{16774 \times 10^{27}{}_{-\nu^{2}}}$$

Oxygen: $$(\mu - 1)_{n.t.p.} \times 10^{7} = 2711(\lambda 5461)$$

$$(\mu - 1)_{n.t.p.} = \frac{3\cdot 4343 \times 10^{27}}{12970 \times 10^{27}{}_{-\nu^{2}}}$$

Gaseous chloroform: $$(\mu - 1)_{d} \times 10^{6} = 1412(\lambda 5461)$$

$$(\mu - 1)_{d} = \frac{14\cdot 622 \times 10^{27}}{10659 \times 10^{27}{}_{-\nu^{2}}}$$

where ν is the frequency of the light, $(\mu - 1)_{n.t.p.}$ is the refractivity for *n.t.p.* conditions, and $(\mu - 1)_{d}$ shows the refractivity by the same number of molecules of the gas as 1 cub. cm. of hydrogen contains at *n.t.p.*

The gaseous refractivities of acetone, methyl ether and ethyl ether for λ5461 were found to be:—

Acetone: $(\mu - 1)_{d} \times 10^{6} = 1096$,
Methyl ether: $(\mu - 1)_{d} \times 10^{7} = 8876$,
Ethyl ether: $(\mu - 1)_{d} \times 10^{6} = 1509$. AUTHOR.

879. Anomalous Dispersion in Phosphorescent Alkali Halides. M. A. Bredig. *ZS. f. Phys.* 46. 1–2. *pp.* 73–79, 1927.

Alkali halides rendered capable of phosphorescence by the addition of small quantities of foreign material can be obtained in optically perfect crystals. By observation of the anomalous dispersion in the neighbourhood of the absorption bands the numbers of electrons taking part can be determined. This has been done for potassium bromide + varying small quantities of lead, as an example of "impurity of the second kind," and for rock-salt which has been exposed to X-rays as an example of "impurity of the first kind" (the "impurity" being finely divided sodium, itself a constituent of the rock-salt mass).

Errata (*ibid.* 46. 11–12. *p.* 899, 1928). A. C. M.

880. Dispersion of Alkali Halides in the Ultra-Violet. Z. Gyulai. *ZS. f. Phys.* 46. 1–2. *pp.* 80–87, 1927.

The dispersion of large crystals of RbCl, NaBr, KBr, KI and LiF has been measured in the ultra-violet by using a spectrometer in conjunction with a source rich in ultra-violet light; the prism was cut out of large crystals of the material under observation, and the observing telescope was provided with a fluorescent ocular to render the light visible. The data are required in connection with the author's work on phosphorescence. [See Abstract 775 (1927).] A. C. M.

881. Dispersion of CO_2 from the Ultra-Violet to the Infra-Red. O. Fuchs. *ZS. f. Phys.* 46. 7–8. *pp.* 519–525, 1928.

A four-term dispersion formula is given which connects the refractivity,

$n - 1$, with the frequencies of the electrons. The formula is tested by using the measurements of six observers from Ketteler (1865) to Stoll (see Abstracts 1659 (1915) and 1119 (1923)], and it is shown to represent with accuracy the value of $n - 1$ from $\lambda = 1800$ Å.U. to $\lambda = 13\ \mu$.
G. E. A.

882. Diffuse and Direct Transmission and their Measurement. W. Dziobek. *ZS. f. Phys.* **46.** 5–6. *pp.* 307–313, 1928.

The author first points out that the definition for diffuse and regular reflection adopted by the International Commission on Illumination is ambiguous, and he applies his reasoning to the analogous problem of transmission through a diffusing medium. When light from a source passes through a diffusing plate, the directly transmitted component obeys the inverse square law reckoning from the position of the source. The diffusely transmitted component follows this law if the plate be regarded as the source. Based on this conception, a method of measuring the two transmission factors is described in the paper. In certain cases, however, the method lacks precision, and in such cases a second method of measurement is preferable. This method is chiefly useful in the case of very dense media when the directly transmitted component is small. It depends on a measurement of the brightness of a very small area of the plate under examination, the measurement being made by means of the Lummer-Brodhun cube, using the Maxwellian view. The apparatus may be modified for measuring the regular reflection factor of a plate of material, and the modification necessary is fully described in the paper. J. W. T. W.

883. Frequencies of Residual Rays, Characteristic Frequencies and Dispersion in the Infra-Red. O. Fuchs and K. L. Wolf. *ZS. f. Phys.* **46.** 7–8. *pp.* 506–518, 1928.

Derives dispersion formulæ, which are related to those of Goldhammer and of Paschen and Martens, and which represent satisfactorily all the measured refractive indices from 1800 Å. to 22 μ and the dielectric constants of KCl and NaCl. The infra-red characteristic frequencies of these crystals have been calculated from these formulæ, and the positions of the maximum of reflection calculated from them agree well with experiment. Matters are simplified in the case of these simple salts, since in more complicated compounds, as Schaefer and his collaborators have shown, characteristic frequencies, due to vibrations of single atoms within such ionic groups as CO_3^{-}, NO_3^{-} or SO_4^{--}, are present in addition to those characteristic of the lattice. These dispersion formulæ make it possible to calculate the values of p, the probability of transference, which have so far been taken as unity, and using these values characteristic frequencies calculated by other methods by Born and by Försterling can be shown to agree with experiment.

Errata (*ibid.* **46.** 11–12. *p.* 899, 1928). H. N. A.

884. Remarks on a Paper by Cabannes on Molecular Diffusion of Light in Liquids. G. Landsberg. *ZS. f. Phys.* **46.** 7–8. *pp.* 604–606, 1928.

To explain the contradiction arrived at in determining Avogadro's number N from the molecular scattering of light Cabannes, in calculating the intensity of the scattered light, made use of an expression for the energy of the acoustic waves based on the quantum theory instead of the classical expression. The author endeavours to show that Cabannes' correction is based on a misunderstanding, since all acoustic waves are not concerned in the scattering of light, but only those whose wave-length bears a certain relation to the wave-length of the light scattered. His theoretical treatment shows that the true correction for the conditions of the Cabannes' experiment, when the quantum theory is employed instead of the classical one, is less than one per thousand. H. N. A.

885. Influence of Salts on the Optical Rotation of Gelatine. Part I. D. C. Carpenter. *J. Phys. Chem.* 31. *pp.* 1875–1879, *Dec.*, 1927.

The gelatine, de-ashed at the isoelectric point by electrodialysis, dehydrated and dried in vacuum at 60° C., was examined in 0·1 % solution at 0·5° C. and at 40° C. in presence of KOH at *p*H = 6·0. The rotatory power of the gel at 0·5° C. was depressed to a small extent by potassium chloride and to a larger extent by the bromide and iodide; in the latter cases the gel was converted into a sol when the specific rotatory power had fallen from − 340° to about − 275°, but the sol became a gel again when the salt was removed by dialysis; the rotatory power also returned to its original value. The rotatory power of the sols at 40° C. was also depressed by the addition of the three salts, but to a relatively insignificant extent, *e.g.*, − 150° to − 100°, the latter value being about the same as that given by KI at 0·5° C. T. M. L.

886. Magnetic Rotation of the Plane of Polarisation in Solutions. O. Schönrock. *ZS. f. Phys.* 46. 5–6. *pp.* 314–326, 1928.

The author points out that Verdet's law for the amount of the magnetic rotation produced by a solution of given strength is often wrongly quoted. The true statement of the law is as follows: $\omega = \omega_1(q_1/s_1) + \omega_2(q_2/s_2)$, where ω is the Verdet constant for the solution (*i.e.* the rotation produced by 1 cm. of the solution in a field of 1 gauss), ω_1 and ω_2 the constants for the solvent and solute, q_1 and q_2 are the grammes of solvent and solute in 1 c.c. of solution, and s_1 and s_2 the respective densities. In the second part of the paper it is shown that when the correct law is used, the observations of previous workers indicate a very high degree of constancy for ω_2 at different concentrations, both for camphor and for $C_{17}H_{28}O_2$ in benzol. J. W. T. W.

887. Quantum Theory of the Polarisation of Impact Radiation. J. R. Oppenheimer. *Nat. Acad. Sci., Proc.* 13. *pp.* 800–805, *Dec.*, 1927.

In a previous paper the polarisation of light excited by electronic impact has been treated, neglecting the spin of the impacting electron, using the quantum theory; the author now treats the problem taking into account this spin and the Heisenberg resonance principle, discarding the assumption that the perturbing energy is small, and finds that in this way the effects with intercombination lines can be explained, and also the experimental fact that the observed polarisation tends, as the energy of the exciting electron is diminished, first towards a maximum, and then, as the energy is further diminished, to zero. The theory predicts that for very high electronic velocities if the excitation is direct there is a polarisation − *p*; this diminishes to zero with the velocity, and then rises to + *p* when resonance velocity is reached; after this the polarisation falls towards zero. For intercombination excitations the momentum rules fail if the spin of the exciting electron changes during the excitation. A method for computing it in this case is given; for other intercombination excitations and for normal excitations the polarisation can be computed by the momentum rule. H. N. A.

888. Theory of the Kerr Effect in Gases. R. de L. Kronig.

ZS. f. Phys. 45. 7-8. *pp.* 458-470, 1927.

Starting from the Kramers-Heisenberg dispersion theory, which is in accordance with quantum mechanics, general formulæ are derived for the differences of refractive index of a gas in an electric field (*a*) for right- and left-handed circularly polarised light, propagated along the field axis, and (*b*) for parallel and perpendicularly polarised light, propagated at right angles to the field axis. The formulæ exhibit the effects of variation of density, temperature, field strength and wave-length. The energies of the stationary states and associated magnitudes are expanded in a power series in the field intensity, and the first order term only is considered in this paper. For monatomic gases it appears that neither longitudinal nor transverse Kerr effects are to be expected. For diatomic gases with permanent dipole moment and electronic impulse moment about the nuclear line, no transverse effect is predicted, and longitudinal effect, only in the immediate neighbourhood of band lines split into doublets as the result of magnetic energy of coupling between nuclear rotation and electronic motion (this effect is not, however, taken into account in the present work). W. S. S.

889. Theory of the Faraday Effect in Gases. R. de L. Kronig.

ZS. f. Phys. 45. 7-8. *pp.* 508-511, 1927.

The formulæ developed by the author in a previous paper [see preceding Abstract] for the refractive indices of a gas in an electric field apply with certain obvious modifications when the electric field is replaced by a magnetic field. A discussion is given of the case of diatomic molecules considered previously in connection with the Kerr effect. The linear (first order) longitudinal Faraday effect is, however, in general different from zero, although the transverse effect again vanishes. W. S. S.

890. Superposition Fringes between Two Semi-Silvered Laminæ formed by Media of Different Indices. G. Simon.

Comptes Rendus, 185. *pp.* 1455-1456, *Dec.* 19, 1927.

Experimenting with water, an interferential receptacle was used consisting of two Perot-Fabry mirrors separated by rubber washers, which rendered adjustable the parallelism of the surfaces. Superposition between the empty receptacle and a lamina of variable thickness gives the rings already described [see Abstract 603 (1928)]. If the receptacle be filled with water in order to reproduce the rings, the thickness of the variable lamina must be increased by about one-third. At their first appearance the rings are alternately green and red. They are succeeded by rings which are almost black on a greenish ground, and then by others alternately bluish and pink. There is no well-defined central ring. Spectroscopic analysis of the light which has traversed the two laminæ shows that in the vicinity of superposition instead of fringes uniformly distributed, as is the case with two identical media, we have a broad fringe surrounded by others which become contracted on each side of it. When the thickness of the movable lamina is gradually increased, very compact fringes appear in the red region, followed by the broad central fringe. This latter shifts from the red to the violet, the lateral fringes appearing at the same time to diverge on each side of it. The dispersion of the optical medium enclosed between the glasses of the first apparatus may be studied by means of a spectroscope graduated in wave-lengths. E. F.

891. Application of the Interference Refractometer to the Measurement of the Concentration of Dilute Solutions. R. Macy. *Am. Chem. Soc., J.* 49. *pp.* 3070–3076, *Dec.*, 1927.

The Haber interference refractometer, made by Zeiss, is capable of giving accurate results rapidly, but may give erroneous indications unless certain precautions are observed. For two substances in the same solution the readings are very nearly, although not exactly, additive. The instrument is more sensitive to aromatic than to aliphatic compounds, and for both classes of compounds there is a general increase in sensitivity with increase in molecular complexity. With urethane and a large number of other compounds highly soluble in water the calibration curve is linear for concentrations up to 3 grammes per litre, but deviates for higher concentrations, possibly owing to a closer packing of the solute molecules. For many compounds of slight solubility in water the calibration curve consists of a series of broken lines, all of the same slope and overlapping slightly. This is due to the fact that introduction of a solution into the cell results in the central black band of the upper interference spectrum becoming tinged with green. With most compounds this green fringe grows wider as the concentration increases, the next band to the left becoming narrower and the red fringe on it less distinct. Within a certain range of concentration it is difficult to distinguish between these two bands, as they have practically no red coloration ; hence a complete calibration curve over the whole range to be studied is mostly essential. The aliphatic compounds do not usually give a break in the calibration curve below 1 gramme per litre, and even sucrose gives a straight, unbroken line. The readings are in all cases proportional to the length of the cell. T. H. P.

892. Development of Interference Spectroscopic Methods. E. Lau. *Zeitschr. f. tech. Phys.* 8. 12. *pp.* 537–540, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

By silvering one side of a Lummer-Gehrcke plate the resolving power is increased. A method of combining two plates for the same purpose is given. As an example of the new arrangement a blackening curve of Hα is shown. J. E.

893. Dependence of the Degree of Turbidity of Disperse Systems of Great Concentrations upon the Refractive Index. G. I. Pokrowski. *ZS. f. Phys.* 46. 9–10. *pp.* 753–758, 1928.

The general scheme of scattering of light in optically heterogeneous media of great concentrations is discussed. On the basis of this theory the attempt is made to relate the scattering coefficient as a function of the refractive index of the disperse phase. The experimental results are compared with the theoretical deductions, and the method of treatment is illustrated by means of these results. F. J. B.

894. Scattering of Light at Slightly Rough Surfaces. M. Leontowitsch. *ZS. f. Phys.* 46. 9–10. *pp.* 739–746, 1928.

Experiments were conducted on unpolished glass surfaces with different degrees of roughness to determine (1) the degree of polarisation of diffusely reflected light, and (2) the dependence of the intensity on the direction of scattering and the wave-length. A Fuess polarisation spectrometer was used and the results for (1) tabulated and shown graphically. For (2) a König-Martens spectrophotometer was employed, the intensity of the light scattered by each surface being compared with that from a magnesium surface. Lambert's law was assumed for the Mg surface, and the intensity of the reflected light for different angles calculated as a function of the angle. The diffraction theory for the scattering of light given by the author [see Abstract 99 (1927)] is true only for small degrees of roughness. The experiments showed that the smoother the surface the better was the agreement with theory, and this holds also for the polarisation of the scattered light and for the dependence of the intensity on the direction of scattering and on the wave-length. The theory of the method is also developed. R. S. R.

895. Intermittent Illumination. Lüppo-Cramer. *Z. wiss. Phot.* 25. *pp.* 61–64, *Dec.*, 1927.

Calls attention to, and supports, Raymond Davis's paper [Bureau of Standards, Sci. Papers, No. 528. pp. 95–139 (1926)], in which it is shown that intermittence of illumination sometimes reduces and sometimes enhances the total latent image formation effect. A. D.

896. Intensification of the Latent Image on Photographic Plates and Films. Part II. Decomposition of H_2O_2 and Mechanism of Latent Image Intensification. E. P. Wightman and R. F. Quirk. *Frank. Inst., J.* 203. *pp.* 731–749, *Dec.*, 1927.

In a previous paper [see Abstract 1731 (1927)] facts are given relative to the effect of H_2O_2, etc., on the latent image. The object of the present paper is to discover the underlying mechanism of latent image intensification. The action of H_2O_2 on the unexposed plate to produce latent fog is not specifically dealt with, but it is inferred that the mechanism of this is quite similar to that of latent image intensification, the difference being merely one of degree and not of kind. The following are the main points dealt with: Decomposition of H_2O_2 in solutions of gelatine-silver sol and of gelatine-silver sulphide sol, and in the presence of hydrogen and bromide ions. Action of H_2O_2-gelatine solution on Ag sol. Action of H_2O_2 on Ag_2S in the presence of acid or alkali and soluble bromide. Prevention of intensification of the latent image by removal of potassium bromide from the emulsion. Action of alkaline H_2O_2 on the photographic plate. A. E. G.

897. Method of Photographic Photometry. G. Landsberg. *ZS. f. Phys.* 46. 1–2. *pp.* 106–108, 1927.

The practicability of the net filter proposed by C. Winther [see Abstract 2152 (1923)] is investigated for the whole spectral region up to 2000 Å. with satisfactory results. A. E. G.

898. Self-Integrating Chemical Actinometry for Ultra-Violet Dosage or other Specific Purposes. M. J. Dorcas and G. S. Forbes. *Am. Chem. Soc., J.* 49. *pp.* 3081–3086, *Dec.*, 1927.

Red-purple Corex glass, together with a 1 cm. layer of 0·00025 M picric acid solution, transmits, at each frequency, a light wattage proportional to the efficiency in producing erythema (sunburn) in human skin. Quinone in 0·002 M solution in 50 % alcohol may be photolysed behind the above filter, which may be compensated at each wave-length, for the photochemical efficiency of this photolysis by means of data (unpublished) obtained by P. A. Leighton. Such a device is able to integrate changes in total intensity and in spectral energy distribution. The losses in the iodine value of the quinone solution (*y*) obtained with seven carbon arcs, both cored and uncored, are proportional approximately to *x*, the reciprocals of the times in which the same sources, without filters, produce a standard erythema; for the more efficient sources, $y = ax + b$ is more accurate.

T. H. P.

899. Impulse Moment of the Light Quantum. A. E. Ruark and H. C. Urey. *Nat. Acad. Sci., Proc.* 13. *pp.* 763–771, *Nov.* 15, 1927.

The correspondence between light quanta and electrons suggests that analogous to the electronic rotation of Goudsmit and Uhlenbeck, there may be a similar property of the light quantum. Some consequences of this idea, which is due to Beck [see Abstract 2881 (1927)], are here worked out. The selection rules for the inner quantum number are consistent with the notion that every quantum emitted has angular momentum $h/2\pi$, although they do not require that this shall be the case. To explain the character of the emission in the ordinary Zeeman effect, in terms of spinning quanta it is, however, found necessary to postulate a certain type of coherence between the individual quanta of a monochromatic beam. Experiments are suggested which may be expected to differentiate between possible views. W. S. S.

900. General Radiation. W. Duane. *Science*, 66. *pp.* 637–640, *Dec.* 30, 1927. *Paper read before the Am. Assoc. for Advancement of Science, Tennessee, Dec.*, 1927.

The impact of electrons against atoms produces two different kinds of radiation: (*a*) the line spectra and (*b*) the general radiation, sometimes called the continuous, or white, spectrum. This paper deals in a general way with the more important characteristics of the latter. A. E. G.

901. The Eikonal Equation in General Anisotropic Media. P. Frank. *Ann. d. Physik*, 84. 7. *pp.* 891–898, *Dec.* 23, 1927.

If the form of a wave front is given at any time by the expression $S(x, y, z) = t$, then S is termed the "eikonal," or wave-function. In isotropic media the eikonal equation takes the form

$$\left(\frac{\partial S}{\partial x}\right)^2 + \left(\frac{\partial S}{\partial y}\right)^2 + \left(\frac{\partial S}{\partial z}\right)^2 = \frac{1}{v^2} = \frac{n^2}{c^2},$$

where *c* and *v* are respectively the velocity of light *in vacuo* and in the given medium at the point chosen, and *n* is the refractive index at the given point. The expressions are then extended in the paper to cover the case for anisotropic media. The paper is wholly mathematical.

R. S. R.

902. Emission Spectra of Various Elements. M. C. Muriel McDonald. *Roy. Soc. Canada, Trans.* 21. *Sect.* 3. *pp.* 223–230, *May*, 1927.

The spectra were generally produced by vapourising the salts in a copper arc and photographed with a quartz spectrograph. Tables of wave-lengths are given for europium, dysprosium, thulium, ytterbium, lutecium, praseodymium and hafnium. The last named has many lines in the region 1870 Å. to 2350 Å. No new lines were found for samarium, gadolinium and erbium. F. S.

903. Under-Water Spark Spectra of Metals. Elizabeth J. Allin. *Roy. Soc. Canada, Trans.* 21. *Sect.* 3. *pp.* 231–235, *May*, 1927.

This is a continuation of previous work [see Abstract 2886 (1927)]. Tables of wave-lengths are given for tungsten, tellurium and thorium. No reversed lines were observed in the case of uranium. F. S.

904. Excitation of the Auroral Green Line in Discharge Tubes. D. A. Keys. *Roy. Soc. Canada, Trans.* 21. *Sect.* 3. *pp.* 257–261, *May*, 1927.

Two forms of discharge tube are described which were used for investigating mixtures of helium and oxygen, and of argon and oxygen. The green line is found to be excited when conditions are such that bands such as the Swan bands are not excited, and hence do not use up the exciting energy. The results support the view that the line is due to oxygen. F. S.

905. Sudden Widening of Spectroscopic Lines owing to the Doppler Effect. G. Polvani. *N. Cimento*, 4. *pp.* 365–370, *Nov.*, 1927.

This phenomenon is studied according to the laws of the new statistics of the perfect gas instituted by Fermi. The resulting divergences from Rayleigh's law being calculated, it is shown that, considering the boundary case of emission at absolute zero, the spectroscopic lines would not be infinitely narrow, but would have a finite breadth, and that for a gas at low temperatures, but only feebly degenerated, the correction to be made in Rayleigh's law is of the same order of magnitude as that to be made in Boyle's law. Mainly mathematical. [See also Abstract 1867 (1926).] E. F.

906. Resonance Radiation in Excited Neon. Y. Fujioka. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, 7. *pp.* 27–34, *Sept.* 30, 1927.

Resonance was produced in neon feebly excited in a discharge-tube by radiation from another discharge tube, and was investigated by direct photographs and by spectrum photographs. Impurities in the emission tube produce no disturbance, but, if in the resonance tube, reduced the resonance markedly. The resonance radiation appeared to be non-polarised. A phase-difference between the exciting currents in the two tubes showed no difference for 500 cycles, but when the frequency was reduced down to 200–150 cycles the resonance disappeared when the phases were opposed. This allows an estimate of the mean life of the metastable atom in fair agreement with Dorgelo's value [see Abstract 545 (1926)]. There was no difference between end-on and side-on illumination. A. C. M.

907. Intensities in the Wood Resonance Series of the Iodine Molecule. O. Oldenberg. *ZS. f. Phys.* 45. 7–8. *pp.* 451–454, 1927.

A resonance series of the iodine molecule is excited by the green mercury line. It has been photographed by the author on special infra-red plates up to 8823 Å.U.—well above the previously reached limit (7687 Å.U.).

These results for the spectrum in emission bear out the conclusions already drawn from the absorption spectrum as to the ease of alteration of the nuclear vibration. [See also Abstracts 375 (1918) and 514 (1924).]

A. C. M.

908. Electronic States and Band Spectrum Structure in Diatomic Molecules. Part VI. Theory of Intensity Relations for Case *b* Doublet States. Interpretation of CH Bands λλ3900, 4300. R. S. Mulliken. *Phys. Rev.* 30. *pp.* 785–811, *Dec.*, 1927.

Theoretical intensity equations are obtained by the summation rule for all possible branches (including " main " and " satellite " branches) in transitions between doublet electronic states falling under Hund's case *b*. A revised notation is proposed, applicable to all known bands and capable of simply describing any band line, for any type of multiplicity. The energy differences between F_1 and F_2 terms (s parallel or antiparallel to j_k in case *b*) are considered qualitatively for a series of cases between case *a* and case *b*, for normal and inverted doublets; with normal doublets, as is shown elsewhere in detail by Kemble, a special case is possible in which s is oriented nearly as $\pm \epsilon$, while $\sigma \sim \sigma_k$, for all but the lowest values of j, so that the Kramers and Pauli formula should hold rather accurately; it is concluded that the ^2P common final state of CHλλ3900 and 4300 is an example of this case. It is shown on the basis of the work of Hulthén and Kratzer that in CHλ4300 the structure (missing lines, number of branches, combination rules, satellite series, term-form) and qualitative intensity relations are in excellent agreement with the theory for a case $b\,^2D \rightarrow {}^2P$ transition; in the case of λ3900 the agreement is equally good with the theory for a case $b\,^2S \rightarrow {}^2P$ transition. Initial term values are given for both bands, making use of Kratzer's accurate formulæ for the final term values. The ^2D initial state of λ4300 shows a very small inverted doublet separation, diminishing with increasing j_k. The F_1 and F_2 levels of the ^2S initial state of λ3900 are very close together, but there is evidence that the F_2 levels are slightly the higher. The three observed levels of the CH molecule are probably low-lying levels. Their relation to the electron levels of the carbon atom is discussed. It is likely that the ^2P, ^2D and ^2S levels of CH are respectively derived from the three lowest states, ^3P, ^1D, and ^1S, of carbon. [See also Abstract 3106 (1927).]

AUTHOR.

909. Band Spectra. E. Hulthén. *ZS. f. Phys.* 46. 5–6. *pp.* 349–353, 1928.

The band spectra of diatomic molecules always contain two partial systems between which only very feeble intercombinations take place. Both partial systems exhibit themselves in relation with the molecules of equal cores as symmetrical and anti-symmetrical systems.

J. J. S.

910. Spectra of CaSrS-Samarium Mixed Phosphors. M. Travniček. *Ann. d. Physik*, 84. 6. *pp.* 823–839, *Dec.* 3, 1927.

In a previous paper [see Abstract 1568 (1926)] the preparation of mixed phosphors of CaSrS (Sm) was given. Here are given the results of the visual examination of the spectra with a Rowland grating. It is established in various ways that the grating constant of the solid solvent determines to some extent the exact place of the luminescent lines: (1) The position of the red band alters with the composition of the phosphor in such a way as to show a parallelism between vibration frequency and grating constant; (2) the spectrum of Sm in $PbSO_4$ is strikingly similar to that in $SrSO_4$—in keeping with the closely similar grating constants. [See next Abstract.] J. E.

911. Spectra of CaSrS-Samarium Mixed Phosphors. E. Rumpf. *Ann. d. Physik*, 84. 6. *p.* 840, *Dec.* 3, 1927.

Remarks on the work by M. Travniček [see preceding Abstract]. The actual composition of the CaS-SrS-Sm phosphorescent grains in a sample was determined from the grating constant, Debye-Scherrer method [see Abstract 250 (1928)]. According to the percentage concentration the wave-length of the red band should have been, on Travniček's curve, 6056·0. It was actually 6057·8. This confirms the possibility suggested by Travniček of estimating the actual composition of mixed phosphors from the position of the phosphorescence bands. J. E.

912. Representation of the Ultra-Red Absorption Spectra of the Hydrogen Halides according to the Schrödinger Theory. M. Czerny. *ZS. f. Phys.* 45. 7–8. *pp.* 476–483, 1927.

The formulæ of the wave-mechanics for the ultra-red rotation and rotation oscillation spectra are found to be in as good agreement with the experimental data for the ultra-red spectra of the hydrogen halides [see Abstract 3126 (1927)] as the formulæ of the earlier quantum theory. Appreciably different values, however, are given for the molecular constants. H. H. Ho.

913. Effect of an Electrical Field on the Absorption Spectrum of Crystals. A. Arsenjewa. *ZS. f. Phys.* 45. 11–12. *p.* 851, 1927.

Joffé has shown that certain crystals traversed by an electric current have the whole fall of potential concentrated in a very thin layer. The field intensity in this layer has very high values, which can hardly be reached otherwise. The author has investigated the effect of this field on the absorption spectrum of a crystal which shows this phenomenon, and found a broadening and flattening of the reflection and absorption maxima. H. N. A.

914. Effect of Temperature on the Absorption Bands of Phosphorescent Alkaline Halides. H. Lorenz. *ZS. f. Phys.* 46. 7–8. *pp.* 558–567, 1928.

An extension of Hilsch's work [see Abstract 96 (1928)]. The effect of change of temperature from + 20° to − 193° C. was observed in crystals of KCl + Tl, KBr + Tl and KCl + Pb. Lowering of temperature causes, in all cases, for long-wave absorption bands a narrowing of the band and also a shift towards the short-wave region. For the crystals named, the shift is 3 to 4 $m\mu$, but is less in crystals of KBr + Tl and KBr + Pb for the short-wave absorption bands. G. E. A.

915. Intensity of an Absorption Line in a Spectrum Produced by a Grating. J. A. Carroll. *Roy. Astron. Soc., M.N.* 88. *pp.* 154–158, *Dec.*, 1927.

The central intensity of an absorption line is considered mathematically. It is shown that the filling in commonly amounts to about 10 %, and a simple relation is given enabling corrections to be applied to deduce the true depth of the line from the observed depth. F. S.

916. Width of Balmer Lines. (Miss) M. Hanot. *Ann. de Physique*, 8. *pp.* 555–625. *Dec.*, 1927.

In the first part of this paper experimental results are given of the effect of electric variables, pressure, etc., on the width of the first few Balmer lines. Curves are given connecting current through and width for currents from 25 to 1550 amperes for H_a and 12 to 700 amperes for the others, the measured widths being from 3 to 15 Å. for H_a, 10 to 55 Å. for H_β and 13 to 85 Å. for H_γ. The lines are produced in a condensed spark. When the pressure varies the width can be expressed by a function of the form lp^m in which l is the width and m has a value of about $\frac{2}{3}$. [See Abstract 1749 (1927).]

The second part contains a discussion of the above results in relation to allied phenomena, such as absorption of the lines in the source itself and intermolecular electric fields. Absorption has been studied with two identical sources in series, and has been found to play only a secondary part as regards its effect on width. The various factors affecting the Stark effect are then considered in detail, including that of damping in the circuit. F. S.

917. Spectrographic Researches in the Intermediate Region. J. Thibaud and A. Soltan. *J. de Physique et le Radium*, 8. *pp.* 484–494, *Dec.*, 1927.

A detailed account is given of work published in brief in the *Comptes Rendus* [see Abstract 361 (1928)]. W. S. S.

918. Band Absorption and Fluorescence of Cadmium Vapour. A. Jabłoński. *ZS. f. Phys.* 45. 11–12. *pp.* 878–891, 1927.

A new absorption band has been found in pure cadmium vapour, which extends from the short wave-length side of 2150 Å. to 1990 Å.; its position and extent have been investigated at different temperatures up to 800° C. in saturated vapour, the absorption rising rapidly with the temperature. A fluorescence band connected with the above extends from 2110 Å. to 2140 Å., with maximum intensity at about 2128 Å.; this occurs at temperatures between 600° and 700° C.; it is most strongly excited by sparks which give strong lines in the region 2110 to 2126 Å., but is also excited, though weakly, by shorter wave-lengths, such as 1990 Å. The new absorption band is the excitation region of the first triplet of the second subsidiary series, 5086 Å., 4800·1 Å. and 4678 Å.; the shorter wave-lengths excite this triplet to a greater extent than they do the fluorescence band. High temperatures favour the triplet as compared with the band. The spectral region which causes excitation of the resonance line is not the same as that which causes band fluorescence. The paper concludes with an attempt to explain the results obtained theoretically. H. N. A.

919. Effect on the Mercury Resonance-Line of Raising the Vapour Pressure. W. Orthmann and P. Pringsheim. *ZS. f. Physik*, 46. 3–4. *pp.* 160–167, 1927.

The broadening of the mercury resonance line (λ2537) due to raising the mercury-vapour pressure is investigated. It is shown that an increase of the vapour pressure by 7·3 mm. is as effective as 250 mm. pressure increase for a rare gas. The weakening of the line is of the same order whether it is caused by increase of mercury-vapour pressure or by addition of a foreign gas, such as hydrogen or oxygen. This observation suggests that the radius of action of the mercury atom is equal to the gas-kinetic radius, while the former one would require it to be very many times greater. This is considered and discussed. A. C. M.

920. Spectra of Gallium, Germanium and Indium. R. J. Lang. *Phys. Rev.* 30. *pp.* 762–769, *Dec.*, 1927.

The vacuum-spark spectra of gallium, germanium and indium have been photographed in the ultra-violet by means of a two-meter vacuum spectrograph using a grating of 30,000 lines per in. The known series lines of GaIII and GeIV have been remeasured and certain new ones discovered. Term values have been recalculated. The series spectra of GaII, GeIII, and InII have been worked out for the multiplets $4^3P - 5^3S$, $4^3P - 4^3D$, $4^3P - 4^3P'$ and $4^1S - 4^1P$. AUTHOR.

921. Infra-Red Radiation of Nitrogen. A. H. Poetker. *Phys. Rev.* 30. *pp.* 812–824, *Dec.*, 1927.

An investigation of the infra-red portion of the first positive group of nitrogen bands by thermocouple and prism has extended that group to the region of 1·5 μ. The broad radiation maxima corresponding to the O, + 1, and + 2 sequences have been broken up into individual bands. Their observed maxima occur at the positions calculated from the known vibration levels of this group. For higher accuracy the region from 7500 to 10,500 Å. was photographed under a dispersion of 9 Å. per mm. with neocyanin plates. The bands were recorded as far as 10,500, the beginning of the O sequence. The measurements of the heads and principal lines within this range are given in tables. From these results values for the bands of the O sequence are found, and those of the − 1 and − 2 sequences are improved. The new data point very definitely to a modification of the assignment of vibration quantum numbers as previously made by Birge, in that the lowest final level should be dropped, and the other vibration quantum numbers should be diminished by one. The evidence pointing to this as the more probable assignment is discussed. Incidentally, the hitherto unresolved O triplet at 9265 Å. appeared clearly resolved on these plates. The wave-lengths were measured as 9265·67, 9262·61, and 9260·31. AUTHOR.

922. Two Devices Facilitating Spectrometry in the Far Infra-Red. R. M. Badger. *J.O.S.A. and R.S.I.* 15. *pp.* 370–373, *Dec.*, 1927.

Describes a balanced thermocouple, in which two thermojunctions are employed, one above the other, on which the image of the slit is focussed, a special arrangement being employed to minimise the effect of the aberrations of the mirrors employed and obtain a sharp image of one-half of the slit on each junction. A spectrometer shutter is used consisting of a very thin glass plate, a plate of rock-salt, or some other material which is transparent from 30 μ to 4 μ and opaque from 30 μ to 100 μ. This can be moved so as to cover either half of the slit, and any of the wave-lengths shorter than 30 μ which get through the filtering devices employed are not affected by the position of this shutter and fall equally on the two thermojunctions, giving a net effect of zero. The longer wave-lengths, on the other hand, are cut off by the shutter from one of the junctions, and the other registers, so that when the shutter is moved and the other junction comes into play there is a double deflection of the galvanometer. An echelette grating is also described, constructed by stacking a number of plane parallel glass plates and clamping in a massive brass frame. The edges are then ground and polished, so that plane surfaces are obtained; one of these surfaces is coated with a reflecting metallic film, and the stack of plates is then staggered so as to form a stairway with equal steps. H. N. A.

923. Zeeman Effect in the Band Spectra of AgH, AlH, ZnH and MgH. W. W. Watson and B. Perkins, Jr. *Phys. Rev.* 30. *pp.* 592–597, *Nov.*, 1927.

The AgH bands were photographed in the second order of a 21-foot Rowland grating using field strengths of 10,000, 13,000 and 33,000 gauss. They show no Zeeman effect. In the case of AlH, only the first few lines in each branch show an effect. The wide doublets of the Q and R branches of ZnH are shown to be quartets, while the P_1 and P_2 lines are unaffected. For MgH there is very large broadening at moderate fields, which decreases with field strength. The transitions in question in each case are discussed. F. S.

924. Zeeman Effect and Spectral Terms in the Arc Spectrum of Platinum. A. C. Haussmann. *Astrophys. J.* 66. *pp.* 333–346, *Dec.*, 1928.

The Zeeman effect of 173 platinum arc lines has been investigated in the region 5500 to 2500 Å., a field of 33,000 gauss and high-dispersion spectrographs being used. It was possible to identify 33 of these lines from their patterns. The *g*-values are found to be usually abnormal and the patterns sometimes unsymmetrical. From the Zeeman patterns, intensities in combinations and Meggers' absorption spectra, 12 low levels have been identified. The grundterm is ${}^3D_3$, d^9s. The assignment agrees well with the prediction of the Hund theory. There are 72 levels altogether, divided into 12 low, 45 intermediate, and 15 high levels. An attempt is made to identify the intermediate levels from intensities in combinations, but no multiplicity is given. To combinations between these 72 levels, there are attributed 376 lines. These account for practically all the strong lines in the arc spectrum. AUTHOR.

925. Shifts and Reversals in Fuse-Spectra. A. C. Menzies. *Roy. Soc., Proc.* 117. *pp.* 88–100, *Dec.* 1, 1927.

Simple means whereby a high-current arc is struck momentarily between wires. The spectrum of Cu thus obtained is compared with the low-current arc spectrum. Five, and possibly six, new terms were discovered, leading to the allocation of thirty-two new lines, of which some are identified with terms missing from Sommer's scheme. The lines which were reversed have final terms which belong to low levels; for Cu they are 1^2S_1 or ${}^2D_2$, or ${}^2D_3$ terms. Lines have a tendency to shift as the current increases; for high-level initial terms having structure (core + *s*) the line shift to the red, or for structure (core + *d*) to the violet; for low-level initial terms the lines shift in accordance with the Stark effect mainly. For iron the magnitude of the shift depends upon the magnitude of the term and on the structure. The iron spectrum is not known sufficiently to decide on the structure of the orbits shifted to the violet; but it is predicted that these will belong to terms having structure d^7, d and d^6s, d. A. D.

926. Continuous Spectrum of Hydrogen. J. Kaplan. *Nat. Acad. Sci., Proc.* 13. *pp.* 760–763, *Nov.* 15, 1927.

Attention is drawn to a continuous spectrum in hydrogen observed by Horton and Davies and others, and possessing the peculiar characteristic of occurring without the presence of either atomic or molecular lines. An explanation is advanced based on the suggestion that when the hydrogen molecule in the first electronic state possesses more than 0·50 volt of vibrational energy it may split into two atoms with radiation. The value 0·50 volt is derived from the short wave-length limit of the continuous spectrum photographed by Lewis. The fact that no lines are observed is merely because transitions from the initial excited state of the molecule to lower ones lead to lines lying beyond that part of the ultra-violet accessible to the quartz spectrograph. W. S. S.

927. Measurements of the Duration of Light in the Components of the Stark Effect for Hydrogen and for the Negative Nitrogen Band 4278 Å. H. Kerschbaum. *Ann. d. Physik,* 84. 7. *pp.* 930–938, *Dec.* 23, 1927.

Measurements were made on the Stark components of H_β and of H_γ of hydrogen by means of observations on canal rays. This ensures that two lines of equal intensity are compared and that the velocity is exactly the same for both lines. Measurements of the blackening produced were made with a Koch self-registering photometer and a Hartmann microphotometer. The method is very similar to that adopted by Gehrcke for demonstration purposes; the canal ray passed between condenser plates, and a lens formed an unmagnified image of it at the place ordinarily occupied by the spectrograph slit; a piece of Iceland spar separated the perpendicularly from the parallel polarised light. The lines were either roughly separated into two components by a field of 60,000 to 70,000 volts/cm.$^{-1}$ or split up to show the fine details by 260,000 volts/cm.$^{-1}$; in the latter case corresponding components were compared, and in all cases the duration of light for both components was the same. An arrangement with mirrors was used to determine the velocity of the carriers of the N_2 bands 4278 Å. (3914 Å.), with a potential of 25,000 volts. The value obtained made it possible to determine the light duration for the negative band 4278 Å.; it is twice as long as that for the spark lines. H. N. A.

928. Inverse Stark Effect of Some Principal Lines of Potassium. W. Grotrian and G. Ramsauer. *Phys. Zeits.* 28. *pp.* 846–856, *Dec.* 1, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.,* 1927.

An arrangement is described by means of which the inverse Stark effect has been investigated for some lines belonging to the principal series of potassium. The shift and separations of the components of the second members of the series has been measured in electric fields up to 100,000 volts per cm. and of the third members up to 84,000 volts per cm. The shifts are to the red and are proportional to the square of the field-strength. The redder line of each doublet only suffers a shift, but the shorter wave-length line splits into two components, of which the weaker one is only shifted one-half to one-third as much as the other. In polarised light the redder line is absorbed, whether parallel or perpendicular polarisation is used. The weaker component of the more violet line is only absorbed when the polarisation is perpendicular, while the stronger component is only absorbed when the polarisation is parallel. These observations are in good accord with the theory of Thomas. A. C. M.

929. Application of Quantum Mechanics to the Stark Effect in Helium. J. S. Foster. *Roy. Soc., Proc.* 117. *pp.* 137–163, *Dec.* 1, 1927.

The general characteristics of the Stark effect in helium and the explanations of the earlier theory are reviewed. The quantum mechanical treatment of the problem given here is based on the Hamiltonian $H = H_0 + \lambda H_1 + \lambda^2 H_2 + \ldots$, where $H_0 = \frac{1}{2m}(p_x^2 + p_y^2 + p_z^2) - \frac{e^2}{r}$ is the Hamiltonian for a hydrogen atom and H_1 is the sum of two terms, one H_1' corresponding to the perturbations produced by the inner central field of force due to the substitution for the hydrogen nucleus, of the helium nucleus and the inner helium electron, and the other H_1'' arising from the external electric field. The terms in λ^2 and higher powers of λ are neglected, so that no account is taken of the second order Stark effect. The displacements at several field strengths are calculated for components of the line groups 2P − (4Q, 5Q), 2S − (4Q, 5Q) and for the corresponding lines of the orthohelium spectrum, considered as singlets. New measurements of displacements of helium components in fields of 100,000 volts/cm. and 83,000 volts/cm. are recorded. Good agreement between calculated and observed displacements is found at all field strengths. The theoretical intensities of the components for fields of 10, 40 and 100 kV/cm. are derived and photographs shown which confirm qualitatively the results obtained. W. S. S.

930. Intensities in the Stark Effect of Helium. Jane M. Dewey. *Phys. Rev.* 30. *pp.* 770–780, *Dec.*, 1927.

The intensities of the new spectral lines appearing in an electric field may be calculated from the quantum theory of perturbations. To apply the method to helium, the helium atom is considered as a perturbed hydrogen atom. Calculations are given for a number of helium lines whose intensities have previously been measured. Measurements of the intensities of the groups 2S − *n*M and 2*s* − *nm* for $n = 4, 5, 6$ and M = S, P, D, etc., are given and compared with the calculated intensities. The theory gives intensities of the correct order of magnitude, and gives the variation with the field approximately correctly, but large deviations from the experimental values appear in all groups. [See also Abstract 1380 (1927).] AUTHOR.

931. Oxygen Bands in the Violet and Ultra-Violet Regions. H. Fesefeldt. *Z. wiss. Phot.* 25. *pp.* 33–60, *Dec.*, 1927.

In this paper are given new wave-length measurements of the oxygen bands in the region λ3140 to λ4450 Å.U. The measurements of the lines were made by means of an Abbé comparator using two microscopes, so that the usual errors were avoided. The measurements were referred to the normal iron spectrum measurements of St. John and Babcock down to λ3400, and below this to tables from Kayser's "Handbook." The reduction of the wave-lengths to vacuo was carried out by means of the formulæ given by Meggers and Peters. [Abstract 282 (1919).] A. W.

932. Spectra of Phosphorus for Different Degrees of Ionisation. G. Déjardin. *Comptes Rendus,* 185. *pp.* 1453–1454, *Dec.* 19, 1927.

The study of the variations observed in the electrodeless discharge leads to the separation of the spectra of phosphorus corresponding to different degrees of ionisation. The whole results may serve as the starting point for the development of the classification devised by Millikan and Bowen. The presence on the spectrogrammes of a large number of new rays shows that the spectra of phosphorus are imperfectly known, particularly in those for ultra-violet beyond 2700 Å. W. V. M.

933. Laws of X-Ray Absorption. J. A. Gray. *Roy. Soc. Canada, Trans.* 21. *Sect.* 3. *pp.* 179–184, *May*, 1927.

Formulæ corresponding to K, L, M absorptions have been found which fit experimental observations much better than others hitherto proposed. J. E.

934. Classical Theories of X-Ray Absorption and Refraction. F. K. Richtmyer. *Phil. Mag.* 4. *pp.* 1296–1302, *Dec.*, 1927.

A general critical survey of classical theories together with a suggestion of a different method of approach by considering the equations of classical optics, which have led to an approximately correct expression for the index of refraction of X-rays. It is shown that these equations also lead to expressions for scattering and like all the classical methods of approach to the problem leave untouched the main part of the absorption process, *i.e.*, that which is proportional to the cube of the wave-length. W. H. Ge.

935. X-Ray K-Absorption in Elements W(74) to U(92), and K Screening Numbers. J. E. Mack and J. M. Cork. *Phys. Rev.* 30. *pp.* 741–754, *Dec.*, 1927.

Values are recorded for the K-absorption edges of elements 74, 76 to 83 inclusive, 90 and 92. Absorption is noted due apparently to the material of the slit but not to the passage of rays through the wedges formed by the jaws of the slit. An attempt is made to determine Sommerfeld's screening numbers for the K shell from empirical data, on the assumption that the first term screening number is a linear function of the atomic number. Since this assumption leads to negative values for the " relativistic " screening number, it is concluded that Sommerfeld's term formula does not account for all the curvature of the lines in the Moseley diagram. Authors.

936. Further Experimental Tests of Theories of the Absorption of X-Rays. F. K. Richtmyer. *Phys. Rev.* 30. *pp.* 755–761, *Dec.*, 1927.

When a beam of X-rays passes through a slab of absorbing material photoelectrons are in general expelled from all levels. If the beam is (1) monochromatic and (2) of wave-length shorter than the K absorption limit of the absorber, the ratio, R_L^K, of the number of photoelectrons coming from (K, L, M . . .) levels to the number coming from (L, M . . .) levels is given by the maximum value $\tau_{\max.}$ reached by the atomic absorption coefficient as the limit is approached from the short wave-length side to the minimum value $\tau_{\min.}$ reached as the limit is approached from the long wave-length side. Because of absence of data on scattering coefficients it is impossible to obtain accurate experimental values of R_L^K for purposes of comparing with experiment the theories of X-ray absorption proposed by Thomson, Compton, de Broglie and Kramers. A careful repetition of the measurements previously reported [see Abstract 1052 (1926)] shows that, after making any reasonable assumption as to the magnitude of the scattering coefficients, the experimental values of R_L^K are more nearly in agreement with Kramers' theory excepting for a small observed variation of R_L^K with λ. However, the absolute magnitude of the absorption discontinuity, *i.e.*, $\tau_{max.} - \tau_{min.}$, is given very closely by de Broglie's theory. A brief report is also made of some preliminary measurements of a redetermination of the variation of absorption with wave-length in which it is hoped to attain considerably higher precision than previously reported. It is shown that in the wave-length range $\lambda_K/2 < \lambda < \lambda_K$ the observed values of the mass absorption coefficient of Sn is a linear function of λ^3 and that the exponent of λ cannot differ from 3 by as much as 1 %. There is no suggestion of a deviation from the λ^3 law as the absorption limit is approached from either side. AUTHOR.

937. Röntgen Rays as a Region of Optics. A. H. Compton. *Zeitschr. f. tech. Phys.* 12. *pp.* 530–537, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

A review of the work of recent years showing the identity of the nature of X-rays and light. The study of the refraction and total reflection has given confirmation to the electron theory of dispersion and enabled the number of electrons in the atom to be determined. By the diffraction of X-rays from optical gratings, the X-ray region has been made to extend to and overlap the far ultra-violet. In diffuse scattering can be traced a gradual transition from the scattering of waves to that of corpuscles. Not only have X-rays now been shown to possess all the properties of light waves, but have to be regarded also as directed quanta. Only those alterations in the laws of optics when extended to X-rays must be made which are indicated by the new wave mechanics. J. E.

938. Röntgen Spectrum of Element 75. O. Berg. *Phys. Zeits.* 28. *pp.* 864–866, *Dec.* 1, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

New spectrograms for the element 75 (rhenium) are given. [See Abstract 192 (1926).] T. H. P.

939. Intensity of Reflection of X-Rays by Crystals at Low Temperatures. R. W. James. *Manchester Phil. Soc., Mem.* 71. *pp.* 9–15, 1926–1927.

The ratio of the intensity of reflection of X-rays from a crystal of rock-salt at the temperature of liquid air to that at ordinary temperatures has been measured for a number of spectra. The results, combined with those obtained earlier for high temperatures, have been compared with the theoretical formulæ of Debye and Waller [see Abstract 1078 (1914) and 2440 (1923)]. They are in fair agreement with Waller's theory up to about 500° abs., but above that the decrease of intensity with temperature is much greater than the theory indicates. [See also Abstract 1661 (1925).] A. B. W.

940. Temperature Factors of X-Ray Reflection for Sodium and Chlorine in the Rock-Salt Crystal. I. Waller and R. W. James. *Roy. Soc., Proc.* 117. *pp.* 214–223, *Dec.* 1, 1927.

The contributions of Na and Cl to the structure amplitude for a given spectrum are proportional to $F_1e^{-M_1}$ and $F_2e^{-M_2}$ where F_1 and F_2 are the

scattering powers of the Na and Cl atoms, and M_1 and M_2 are functions of the temperature. Over a considerable range of temperature $M_\kappa = 8\pi^2 \sin^2 \theta\{a_\kappa + \beta_\kappa T + \gamma_\kappa \sqrt{T} + \delta_\kappa \sqrt{T^3} + \ldots\}/\lambda^2$, where T is the absolute temperature; β_κ depends on the interatomic forces, and the values of β determined from the experimental results of James and Miss Firth give for the weighted mean $\overline{\beta} = 5\cdot 8.10^{-21}$, while using Voigt's values for the elastic constants of rock-salt $\overline{\beta} = 5\cdot 7.10^{-21}$. At corresponding temperatures and glancing angles M_1 is greater than M_2, assuming the existence of zero-point energy; this means that the Cl atoms are the more closely bound. The root mean square amplitudes of vibration at 290° abs. are 0·242 Å. for Na and 0·217 Å. for Cl. The values of F for Na and Cl have been calculated. Curves have been obtained showing the variation of intensity of reflection of X-rays with temperature for the (400), (600) and (800) spectra of rock-salt, and these are compared with the measurements of James; there is agreement up to 500° abs. Waller's formula for the temperature coefficient agrees with experiments from 86° abs. to about 500° abs.
H. N. A.

941. X-Ray Diffraction in Liquids: Saturated Normal Alcohols, Isomers of Primary Normal Alcohols and Normal Paraffins. G. W. Stewart. *Nat. Acad. Sci., Proc.* 13. *pp.* 787–789, *Dec.*, 1927.

A continuation of the work of Stewart and Morrow [see Abstract 371 (1928)]. Isomers of primary normal alcohols: The intensity curves of an alcohol and its isomers show distinct differences. The attachment of CH_3 as a side branch alters the "diameter" by 0·6 Å.U., and of OH by 0·4 Å.U. The attachment of CH_3 and OH to the same atom in the cabin only alters the diameter by 0·65 Å.U. Existence is shown of polar groups giving molecules in a continuous chain.

Normal paraffins: There is only one peak in the ionisation curve—the one corresponding to a longitudinal spacing being absent. The single peak occurs at the same angle with each *n* paraffin except pentane and decane, which are thought to be isomers. The lateral separation is approximately 4·6 Å.U. It is claimed that the results give strong support to the interpretation of liquid patterns as due to a molecular space array in liquids.
J. E.

942. Scattering of X-Rays by Gases. J. A. Gray and H. M. Cave. *Roy. Soc. Canada, Trans.* 21. *Sect.* 3. *pp.* 157–161, *May*, 1927.

The distribution of radiations scattered by certain gases has been determined by a continuous flow method. The scattering function F, for a single molecule, is for small angles of scattering proportional to the number *n* of electrons on the molecule. For zero angle of scattering it is doubtless equal to *n*, over the range of wave-lengths used. $I_0/I_{\pi/2}$ is of the order $2n$, $F_0/F_{\pi/2}$ is of the order $\sqrt{n}$ values considerably smaller than those obtained for atoms by measurements of X-rays reflected from crystal planes. The difference is mainly due to the fact that in the latter case the unmodified radiation only contributes to the final result.
A. B. W.

943. Recoil Electrons from Aluminium. A. A. Bless. *Phys. Rev.* 30. *pp.* 871–877, *Dec.*, 1927.

Electrons recoiling from aluminium as a result of the scattering of X-rays were analysed by a magnetic field and detected by their effect on a photographic film. The filtered radiation from a tungsten tube (effective wave-length 0·48 Å.) and the MoKα rays (λ0·712 Å.) from a molybdenum tube were used. The maximum energy of the recoil electrons as determined from the position of the high-velocity edge of the blackening on the films is expressed in terms of ν/R(ν, the frequency of a quantum having the same energy; R, Rydberg's constant). The values obtained are 190 for the 0·48 Å. rays and 84·1 for the 0·712 Å. rays. According to the Compton theory of scattering based on the assumption that radiant energy travels in the form of quanta having a definite momentum as well as a definite energy associated with them, the electrons scattering the X-ray quanta recoil with a maximum energy $\mathrm{E} = 2\alpha h\nu/(1 + 2\alpha)$, where $\alpha = h\nu/mc^2$. On the Wilson postulate that the scattered radiation travels in the form of spherical waves the maximum energy of the recoiling electrons would be about one-fourth that given above. For the two wave-lengths used in the above experiment the values of ν/R computed by the Compton formula are 172·5 and 81·0 respectively while those computed by the Wilson formula are 43·1 and 20·2. The experimental results thus distinctly favour the Compton theory. AUTHOR.

944. Spatial Distribution of the Electrons produced by Polarised X-Rays. F. Kirchner. *Ann. d. Physik,* 84. 7. *pp.* 899–906, *Dec.* 23, 1927.

A continuation of the work described previously [see Abstract 2925 (1927)]. The observed spatial distribution in a Wilson chamber cannot, as was thought by Watson, be explained in terms of scattering from the gas. The latest measurements by Loughridge for unpolarised rays show that the form of the distribution is independent of the nature of the gas, as was proved previously by the author for polarised radiation. W. V. M.

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945. Breadth of X-Ray Spectrum Lines. D. Coster. *ZS. f. Phys.* 45. 11–12. *pp.* 797–801, 1927.

The " natural " breadth of X-ray spectra lines is explained on the basis of the inner structure of the atom. [See also Abstract 1429 (1927).] A. B. W.

946. Deviations from the Moseley Law. V. Dolejšek. *ZS. f. Phys.* 46. 1–2. *pp.* 132–141, 1927.

Continuing former researches [see Abstracts 2095 (1922) and 2077 (1927)] and referring to Thoraeus [Abstract 1411 (1927)], the author applies his empirical formula for $\sqrt{\nu/\mathrm{R}}$ in controlling the accuracy of the observed K, L, etc., lines and levels of groups of elements throughout the periodic table. The deviations from the Moseley law are strongest near the inert gases and atomic numbers 36, 54, 86, and increase in that order, while the deviations vanish for the Bohr elements of distinctive character 28, 46, 87. The author calls these deviations, which are not connected with the general trend of the curves, periodicity fluctuations. They are mostly too small for observation, or would fall within the experimental errors. Similar relations hold for the variations in the differences of doublet lines. The periodicity fluctuations are smaller, and their equations simpler, for the lines than for the levels. H. B.

947. Further Contribution to the Intensity Relationships in the L-Röntgen Series. A. Jönsson. *ZS. f. Phys.* 46. 5–6. *pp.* 383–391, 1928.

This paper includes measurements, which are corrected for anti-kathode absorption, of the relative radiation energies of the stronger lines in the L-Röntgen spectra of the metals Mo, Ph, Pd and Ag. It has been found that the doublet $L\alpha_1, \alpha_2, \beta_1$, as well as *l*, *n*, obeys the intensity rules found within the optical range. For the doublet β_2, γ_1, however, these rules appear only to be valid for metals in which the $N_{IV, V}$ levels are completely filled with electrons. [See also Abstract 2079 (1927).]

H. H. Ho.

948. Influence of the Form and Polarity of Molecules on the Röntgen Spectra of Liquids. Part II. Appearance of Two Intensive Amorphous Rings with Substances whose Molecules contain Several Equal Groups or Parts. J. R. Katz and J. Selman. *ZS. f. Phys.* 46. 5–6. *pp.* 392–405, 1928.

In the Röntgen spectrograph of most liquids only a single intensive amorphous ring occurs, and its connection with the average distance of the molecular centres was studied in Part I [see Abstract 120 (1928)]. In many cases, however, two such rings appear in the diagram which seem to depend on a definite structure of the molecule. In the present paper a group of such substances have had their Röntgen spectra determined, and the alterations of the latter for cases of polymerisation have also been investigated. It has been found that the form of the molecule—its parts and groups—is as important for the theory of liquid spectra as the magnitude of the molecular volume of the liquid. These multiple liquid interferences may possibly indicate that the liquid molecules for the most part lie in very small groups within which certain parallel orientations may arise.

H. H. Ho.

949. K-X-Ray Spectra of Tungsten. K. C. Mazumder. *ZS. f. Phys.* 46. 5–6. *pp.* 449–450, 1927.

The K series of elements of high atomic number have usually four lines—α_2, α_1, β_1 and γ_1, in order of increasing hardness. A line $K\alpha_3$ is here described as measured in the first order of the spectrum of tungsten with a wave-length 0·218 Å. It is forbidden by the selective principle, but is supposed to appear on account of the strong fields near the anti-kathode.

A. C. M.

RADIOACTIVITY.

950. Bohr Magneton and Radioactivity. D. Enskog. *ZS. f. Phys.* 45. 11–12. *pp.* 852–868, 1927.

Assumes that the α- or β-particle is held to the residual nucleus before disintegration mainly by magnetic forces. Each of the bodies concerned has a definite charge and a magnetic moment, and from these the potential energy, the forces acting, the distance between the bodies at which the energy has a maximum value, and the amount of this maximum is deduced. When the α-particle accumulates kinetic energy greater than this maximum value it can break away from the residual nucleus. The author assumes a quantification of the magnetic energy expressed in Bohr magnetons, the quantum numbers employed being ratios such as 4/3, 2/3, 1/2, 1/3, 2/5, 4/5, 6/5, 1/1, and obtains values of the energy of disintegration of different radio-active substances which agree with the observed values within the experimental errors. In addition to this, upper limits are obtained for the possible nuclear charge, together with qualitative relations between the energy and the probability of disintegration.

H. N. A.

951. Behaviour of Small Quantities of Radon at Low Temperatures and Low Pressures. A. F. Kovarik. *Phil. Mag.* 4. *pp.* 1267–1275, *Dec.*, 1927.

Radon was condensed in a small U-tube at various low temperatures, and the radon gas in equilibrium with it in a bulb was shut off, collected and measured by the ionisation method. The deduced vapour pressure was found to be given by the equation $\log P = -968{\cdot}479/T + 0{\cdot}3021 \log T + 1{\cdot}158$. There are, however, irregularities much greater than the experimental errors. It is suggested that the condensed radon is partly a monatomic layer on the cold glass surface and partly minute frozen droplets. Each of these forms has its own volatilisation temperature, about 116° and 121° absolute. Other observers have obtained values ranging from 113° to 123° absolute for this temperature. H. N. A.

952. Radioactivity of Potassium. G. Hevesy. *Nature*, 120. *pp.* 838–839, *Dec.* 10, 1927.

By repeated distillation of potassium in a high vacuum, with the hot and cold surfaces separated by less than 1 cm., potassium was obtained the atomic weight of which was determined by Hönigschmidt and found to be $0{\cdot}005(\pm 1)$ unit in excess of ordinary potassium. The radioactivity was compared with that of ordinary potassium by G. Hoffmann, with the vacuum electrometer; the difference was $4{\cdot}2 \pm 0{\cdot}7$ %. This agrees with the change in atomic weight if the activity is due to the isotope with mass 41, while that with mass 39 is inactive. Holmes and Lawson give $1{\cdot}5 \times 10^{12}$ years for the half-value period of potassium, assuming that both isotopes are active; since only the 41 isotope is active, this period becomes $7{\cdot}5 \times 10^{10}$ years. The transformation product, if the nucleus simply loses a β-particle, is a calcium isotope of atomic weight 41; about 2 % of the original amount of K41 has decayed since the earth's crust consolidated, so that the maximum amount of Ca41 which can have accumulated in potassium minerals will be $0{\cdot}1$ % of their potassium content. It should be possible to detect this by determining the atomic weight of calcium extracted from old potassium minerals. H. N. A.

953. Elasticity of Collisions of α-Particles with Hydrogen Nuclei. P. M. S. Blackett and E. P. Hudson. *Roy. Soc., Proc.* 117. *pp.* 124–130, *Dec.* 1, 1927.

Using the Wilson cloud method as in previous investigations [see Abstract 2211 (1923)] an investigation has been made of certain effects observed in the close collisions of α-particles with hydrogen nuclei. A study of two of the best photographs obtained of such close collisions has shown these to be perfectly elastic within the limits of experimental error. The least detectable loss of energy in a collision, expressed as a fraction of the final energy of the proton, is found for the most favourable track to be as low as $1\frac{1}{3}$ %. This corresponds to a 4 % alteration in range. The probable accuracy of the measurements is discussed. A. B. W.

954. Oblique Incidence of α-Particles on Mica. H. De. *Phys. Rev.* 30. *pp.* 960–962, *Dec.*, 1927.

The oblique incidence of α-particles on mica surfaces has been studied in a Wilson condensation chamber. Bose [see Abstract 920 (1923)] attributed a tail, which appears with the incident α-particle track, to ionised adsorbed gases on the surface upon which the α-particles are impinging.

The new explanation as here offered is that the tail is due to the diffusion of the ions repelled by the charged sheet upon which the α-particles are incident. AUTHOR.

955. Ionisation Curve of an Average α-Particle. N. Feather and R. R. Nimmo. *Cambridge Phil. Soc., Proc.* 24. *pp.* 139–149, *Jan.*, 1928.

The Wilson cloud expansion apparatus was employed, the explosion of a tungsten wire replacing the quartz mercury lamp; α-particles from a source of thorium active deposit were employed. The tracks were measured photometrically along their length, so that it became possible to calculate the variation of the light-scattering power of an α-particle track over the last 2 cm. of its length in standard air. The variation of this quantity was identified with the variation of ionisation along the track. Air, helium and hydrogen have been experimented with; in these gases the maximum ionising efficiency is found when the velocity of the α-particle corresponds to that at 3·0, 2·55 and 2·25 mm. respectively from the end of the track in standard air. The paper concludes with some theoretical considerations bearing on the results obtained. In the case of hydrogen and helium, matters are not greatly complicated by the capture and loss phenomenon, and there is considerable probability of the α-particle retaining its ionising power nearly to the end of its range. The striking difference between the shapes of the air and helium remains unexplained. H. N. A.

956. Passage of α-Rays and β-Rays through Matter. E. J. Williams. *Manchester Phil. Soc., Mem.* 71. *pp.* 23–39, 1926–1927.

Experimental results for the number of ions per unit length of track produced by β-rays ($v = 5 \times 10^9$ cm./sec.) in hydrogen, nitrogen and oxygen are given. The theoretical values, according to J. J. Thomson's theory, account for only about one-half of the observed ionisation. New calculations are given in which the motion of the atomic electrons is taken into account. The necessary data for the calculation of the theoretical values is most certain for hydrogen, and in this case the new theoretical value is within the experimental error of the observed value. In discussing stopping powers, values for β-rays recently obtained by J. M. Nuttall and the writer are used [see Abstract 1047 (1927)]. These are free from errors arising from the scattering of the β-rays. The atomic stopping powers for α-rays and β-rays and the relation between them are discussed. A. B. W.

957. Relative Ranges of β-Rays. J. A. Gray and B. W. Sargent. *Roy. Soc. Canada, Trans.* 21. *Sect.* 3. *pp.* 173–178, *May*, 1927.

The relative ranges of the β-rays of RaE and UrX_2 in carbon, aluminium, copper, tin and lead have been determined. The range is found to increase with the atomic number, and the stopping power of an atom for the β-rays of UrX_2 is approximately proportional to the atomic number. A. B. W.

958. Retardation of β-Rays by Matter. J. d'Espine. *J. de Physique et le Radium*, 8. *pp.* 502–507, *Dec.*, 1927.

The author has studied the loss of velocity in β-rays in passing through matter by means of the method of deflection in a magnetic field. The

β-rays employed were the principal groups from ThB and from RaB. Bohr's theory is found to explain the experimental results. A. B. W.

959. Efficiency of β-Ray Recoil in the Case of Thorium B. K. Donat and K. Philipp. *ZS. f. Phys.* 45. 7–8. *pp.* 512–521, 1927.

The method used is in the main that employed by Barton in measuring the efficiency of β-ray recoil of RaC from RaB, with an additional arrangement by means of which the ThB can be doubly distilled *in vacuo* before the measurement of the recoil of ThC from ThB, when the latter sends out a β-particle, is measured. The surface of the recoil atom receiver is cup-shaped, and it is placed in such a position with respect to the plane surface on to which the ThB is distilled that practically the whole of a solid angle $\omega = 2\pi$ can be utilised. At the same time as the β-recoil an α-recoil of ThC″ from ThC takes place, and this makes possible a convenient control of the geometrical relations and the method of measurement employed. The yield for the recoil of ThC from ThB was found to be from 2 to 6·5 %. This is of the same order as that found by Barton for the recoil of RaC from RaB, but his explanation of the low efficiency is not confirmed. Another explanation is suggested which depends on the kinetics of condensation. H. N. A.

960. Usefulness of the Geiger Point Counter for β-Rays of Different Velocities and the Number of β-Rays from RaE and RaD. N. Riehl. *ZS. f. Phys.* 46. 7–8. *pp.* 478–505, 1928.

Investigates the possibility of counting β-rays with velocities of from 34 to 94 % of that of light and what pressure must exist in the counter for this purpose. Pressures of from 7 mm. to 2½ atm. were experimented with, and it was found that for the β-rays of RaE, with velocities of 70 to 94 % of *c*, a pressure of at least 1150 mm. was required to obtain a full count when air was used; for those of RaD, with velocities of 34 to 40 % of *c*, 7-mm. pressure was sufficient. A magnetic field was employed to deflect the β-rays of different velocities by degrees from the opening of the counter, until finally only the α-rays from the polonium, which was the final product of the RaD employed, entered the counter. Since in the counts on the RaE β-rays the three elements RaD, RaE and polonium were in equilibrium, a count of the α-rays gave the number of atoms of each element disintegrating during the time of observation. It was shown that more than 1·2 β-particles were given off by RaE per atom disintegrating. With RaD the number of β-particles counted was less than the number of atoms disintegrating. It seems probable that the velocity of the primary β-rays from RaD is less than, or at most equal to, 20 % of *c*. H. N. A.

HEAT.

961. Boundary Value in the Generalised Equation of Thermal Conductivity. A. Huber. *Zeits. Math. u. Mechanik*, 7. *pp.* 469–476, *Dec.*, 1927.

§ 1 of this mathematical paper discusses the solution of the equation $\partial^2 z/\partial x^2 - x(x)\partial z/\partial y = 0$, and § 2, dealing with the boundary conditions, derives a solution $\zeta(x, y)$ which satisfies the following conditions:

$$\lim_{x \to +0} \zeta = f(y); \quad \lim_{y \to +0} \zeta = 0; \quad \lim_{x \to \infty} \zeta = 0.$$

§ 3 considers the equation $\partial^2 z/\partial x^2 - x^2 \partial z/\partial y = 0$, and § 4 discusses an example of its application to the care of moisture equalisation by exchange movement. H. H. Ho.

962. Thermal Conductivity of Certain Liquids. G. W. C. Kaye and W. F. Higgins. *Roy. Soc., Proc.* 117. *pp.* 459–470, *Jan.* 2, 1928.

A "plate" method is used, the apparatus being completely enclosed in a thermostat. Results are obtained at temperatures 20° to 200° C. (where possible). Corrections are made where necessary for lateral loss of heat, heat transferred through liquid outside the thin film concerned, heat lost by evaporation from this outside liquid, heat through the guard plate, and heat conducted through distance pieces used to keep the hot plate at known distance from the cold plate. The thermal conductivity is then given by $Wd/4{\cdot}18A\delta\theta$, where W is the watts supplied to the hot plate, d the thickness of the liquid film, A the area of each plate, and $\delta\theta$ their difference of temperature. A linear relation between conductivity and temperature is found for all liquids examined, the results being as follows:—

Liquid.	Conductivity at 20° C.	Temperature Coefficient a in $K_t = K_0(1 + at)$.
Water	$0{\cdot}0014_9$	$+ 0{\cdot}001_2$
Glycerine	$0{\cdot}00068_0$	$+ 0{\cdot}0005_3$
Castor oil	$0{\cdot}00043_2$	$- 0{\cdot}0005_0$
Aniline	$0{\cdot}00041_2$	$0{\cdot}0000$
Olive oil	$0{\cdot}00040_2$	$- 0{\cdot}0003_5$
Cylinder oil	$0{\cdot}00036_6$	$- 0{\cdot}0004_1$
Transformer oil	$0{\cdot}00032_1$	$- 0{\cdot}0006_2$
Medicinal paraffin	$0{\cdot}00030_0$	$- 0{\cdot}0000_7$
Paraffin oil	$0{\cdot}00029_8$	$- 0{\cdot}0005_5$

T. B.

963. Relations between Heat Transfer and Friction. A. Sellerio. *Phys. Zeits.* 29. *pp.* 55–57, *Jan.* 15, 1928.

The formula for heat transfer proposed independently by Lorenz [see Abstract 2567 (1927)] is correlated with Reynold's formula and an expression deduced for the dependence of heat transfer upon thermal conductivity and viscosity. J. S. G. T.

964. Liquid Wires and their Surface Films. W. B. Pietenpol and H. A. Miley. *Phys. Rev.* 30. *pp.* 697–704, *Nov.*, 1927.

The authors have repeated the experiments of Damianos [see Abstract 1857 (1926)], and show that the phenomenon is due to an oxide film strong enough to sustain the molten metal. An oxidised lead wire was lowered into an electric furnace; the melting of the wire progressed upwards very quickly, and when a length was melted the weight of which was enough to break the oxide film that part of the wire fell. From the length measurement the force necessary to break the film could be calculated. This was done with wires of different radii and the radii were plotted against the " breaking volumes "; the graph showed strict proportionality. The cross-section of the oxide film varies as the circumference of the wire, and so its breaking load varies as the radius. The " breaking volume " or " breaking weight " also varies with the radius, so that the above linear relation is to be expected. If the melted lead were able to resist a tension the breaking strength would be proportional to the square of the radius. The ability of sulphide, bromide and chloride films to support molten wires was also tested. If the melting point of the coat is between the melting point of the metal and the glowing temperature, the wire breaks at the melting point of the coat; in some cases the coat melted above the glowing point and the wire could be made to glow. The temperature coefficients of resistance as the metal passes through the solid and liquid states can be measured by means of wires with oxide films. H. N. A.

965. Thermoelastic Stresses in a Hollow Cylinder. Y. Ikeda and E. Kato. *Hokkaido Imp. Univ., Mem.* 1. *pp.* 127–153, *Dec.*, 1927. *In English.*

The differential equations for the thermoelastic stresses in a hollow cylinder are solved when the inner surface is kept adiabatic and the outer surface is kept cooled. The maximum hoop stress depends on the rate of cooling; a critical cooling curve for a glass cylinder is given. Experiments with glass cylinders showed that they cracked if cooled too quickly, and fair agreement was obtained between the critical rate of cooling calculated and determined from the experiments. Suggestions are made with reference to the heating and cooling of metal ingots. W. G. B.

966. Specific Heat of Electrolytes. K. Bennewitz. *Z. El. Ch.* 33. *pp.* 540–542; *Disc.*, 542, *Dec.*, 1927. *Paper read before the Deut. Bunsen Gesell., Dresden, May,* 1927.

Points out the possibility of a negative specific heat, when the external virial can be neglected, as in the case when the system has a characteristic volume and requires no containing walls. As an example is given the case of a spherical mass of gas subjected to gravitational and Coulomb forces, as found in the initial enormously rarefied stages of stars. Such a sphere when it loses energy gets hotter and contracts, and its specific heat is negative. The author considers that something of the same kind may be true of the ions of an electrolyte, when the dilution is so great that they are at such a distance from one another that there is little if any mutual action between them. He examines some of the available data and finds evidence which he considers confirms this view. In the *Discussion*, **Tamman** and **Eucken** were unable to accept the author's theory.

H. N. A.

967. The Difference $c_p - c_v$. A. Batschinski. *ZS. f. Phys.* 45. 11–12. *pp.* 892–894, 1927.

Criticises the statement found in some textbooks that the equation $c_p - c_v = AR$ for ideal gases can be deduced from the energy principle, without using the entropy principle, when c_p and c_v are variable. Calls attention to an oversight by Bertrand, who has attempted to find the form of the equation of state of a substance for which $c_p = F(T)$ and $c_v = f(T)$. This oversight limited the applicability of the solution found, but this limitation is not correct. Calculates the values of $c_p - c_v$ from the observations of Tamman for a number of organic liquids at 1000 to 3000 atm.; the values are about 30 % lower than those calculated by Schulze for atmospheric pressure. Finds the equation of state of a substance for which $c_p - c_v$ has the constant value AR. H. N. A.

968. Experimental Test of Maxwell's Distribution Law. J. A. Eldridge. *Phys. Rev.* 30. *pp.* 931–935, *Dec.*, 1927.

A method is described for obtaining a velocity spectrum of a metallic vapour. The apparatus consists of a number of coaxial discs with radial slots which rotate at high speed and serve as a velocity filter for the molecules. The velocity can be measured directly somewhat as in the Fizeau experiment. The apparatus has been used to measure the distribution law of molecular velocities in cadmium vapour and it is found to agree with that of Maxwell within experimental error. AUTHOR.

969. Effective Cross-Section of Gas Molecules in Chemical Kinetics. G. Kornfeld. *Zeits. phys. Chem.* 131. *pp.* 97–104, *Dec.*, 1927.

Considerations relating to the various effective cross-sections of gas molecules in gas reactions and at different temperatures and pressures. A. B. W.

970. Molecular Aggregation. Theory of Liquefaction. Y. Rocard. *J. de Physique et le Radium*, 8. *pp.* 495–502, *Dec.*, 1927.

The author shows that the hypothesis of molecular aggregation given by certain investigators, and excluding intra-molecular forces, does not explain temperature variations of the viscosity coefficient of the gas. Invoking the hypothesis of intra-molecular forces, the author obtains agreement with experiment and develops a theory of liquefaction. A. B. W.

971. Pressures produced on Inflammation of Mixtures of (*a*) Carbon Monoxide and Air, (*b*) Hydrogen and Air in a Closed Spherical Vessel. G. B. Maxwell and R. V. Wheeler. *Chem. Soc., J. pp.* 15–21, *Jan.*, 1928.

Determinations of pressures developed on the inflammation of mixtures of air and paraffins led to doubts of the Nernst and Bjerrum values for the dissociation of carbon dioxide. The pressure developed on the explosion of mixtures of carbon monoxide and air in a closed spherical vessel was determined. The pressures were measured by a Petavel gauge and a moving piston gauge. It was found that the maximum pressure was developed when a mixture of 35·5 % carbon monoxide and air were exploded, and the pressure developed was 6·72 atmospheres. The dissociation of carbon dioxide deduced from the results are more in agreement with those of Fenning and Tizard than with the results of Nernst and Bjerrum. The explosion of mixtures of hydrogen and air developed the maximum pressure when the mixture contained 32·5 % hydrogen, and the pressure reached was 6·98 atmospheres. Calculations of the specific heat of steam were made for mixtures of steam and hydrogen, so as to repress the dissociation of the steam. F. J. B.

972. Vapour Pressures of Potassium Amalgams. R. W. Millar. *Am. Chem. Soc., J.* 49. *pp.* 3003–3010, *Dec.*, 1927.

The vapour pressures of mercury in equilibrium with five potassium amalgams have been measured. The concentrations ranged from 5 to 32 mole % of potassium and the temperatures from 184° to 445°. The equation of van Laar, which expresses the vapour pressure as a function of the concentration, temperature being constant, has been found to agree with the experimental data within the limits of accuracy of the latter. The relative partial molal heat content of solvent mercury in the amalgams not exceeding 8 mole % of potassium was found to be zero. The deviations from Raoult's law are among the greatest yet noted in any solutions, and, as is to be expected, they decrease with rising temperature. H. H. Ho.

973. Vapour Pressure of Sodium and Cæsium Amalgams. H. E. Bent and J. H. Hildebrand. *Am. Chem. Soc., J.* 49. *pp.* 3011–3027, *Dec.*, 1927.

Measurements of the vapour pressures of sodium and cæsium amalgams at temperatures between 554° and 651° K. and for values of N_1, the mol. fraction of mercury, between 1 and 0·5 yield results expressible by the equation $\log a_1/N_1 = KN_2^2/T$. Calculation of the relative partial molal heat content of mercury in the amalgams from the temperature coefficient of the activity renders possible calculation of the free energy of transfer of mercury in amalgams at intermediate temperatures and over the range of concentration employed. Approximate values for the free energy of transfer of alkali metal to amalgam are also obtained, and comparison is made between the values for sodium, potassium, cæsium and barium of the constant β, which expresses the deviation of both solvent and solute from Raoult's law. The whole of the deviation from perfect solution exhibited by sodium amalgams is explainable on the assumption of compound formation, formation of the compounds $NaHg_2$, $NaHg_4$, and $NaHg_6$ explaining the vapour pressures of amalgams from activity 0·1 to 0·9 and that of $NaHg_{16}$ in very dilute amalgams, both vapour pressure and e.m.f. data. T. H. P.

974. Relation of Vapour Pressure to Particle Size. S. L. Bigelow and H. M. Trimble. *J. Phys. Chem.* 31. *pp.* 1798–1816, *Dec.*, 1927.

Consideration of the Thomson equation, $\log P'/P = 2\gamma M/rsRT$, leads to the conclusion that it is only applicable within very narrow limits. It was shown that when sulphur droplets were kept liquid no measurable distillation occurred. This was shown to be the case for sulphur, phosphorus and other liquids which wet glass. Evidence was found to support the view that a liquid forms droplets on a surface which it wets, and that the droplets are in equilibrium with the film of liquid on the solid between them. Mercury droplets were found to grow at the expense of smaller drops. Crystals of iodine, naphthalene, and camphor did not appear to grow at the expense of smaller crystals. Distillation between a large and small meniscus was found to be so slow that it was impossible to measure the equilibrium position for any meniscus, with reference to a large surface of the same liquid. No quantitative data were found to support the Thomson equation, probably due to the fact that the effects formulated by the equation were so small that they are usually obscured or obliterated by other causes and effects which are present. F. J. B.

975. Radiation Fluctuations and Thermal Equilibrium. S. Jacobsohn. *Phys. Rev.* 30. *pp.* 936–943, *Dec.*, 1927.

In the definition of the fluctuation of energy of an oscillator with one degree of freedom there exists an ambiguity involving the energy variation during a single vibration. Only by ignoring this variation is it possible to arrive at the correct fluctuations in a Jeans cube. The energy fluctuations can be accounted for if the radiation in an enclosure is regarded as due to the disturbed vibrations of the charges on the walls provided these disturbances follow, for each mode of vibration, the law of phase relations given by Planck. The method used by Einstein and Hopf for the linear oscillator is extended to the case in which such phase relations exist in the Fourier analysis, and in this case it is shown that thermal equilibrium can be accounted for even though the radiation formula be that of Planck and the electromagnetic theory be used throughout. AUTHOR.

976. Fluctuations in Black-Body Radiation. S. Jacobsohn. *Phys. Rev.* 30. *pp.* 944–947, *Dec.*, 1927.

The method used by Ehrenfest [see Abstract 1756 (1926)] for the calculation of energy fluctuations in a one-dimensional continuum is adopted for a re-examination of Lorentz's calculation in the three-dimensional case. It is shown that on the basis of the quantum statistics this goes through and yields the result required by the Planck formula. The difficulty that the fluctuations involve a term depending on the square of volume appears here also, and a suggestion is given as to the source of the difficulty which promises information on the structure of the light-quantum. AUTHOR.

977. Zero-Point Conditions. W. Jazyna. *Phys. Zeits.* 28. *pp.* 908–911, *Dec.* 15, 1927.

The lowering of temperature ordinarily leads to two different expressions for the final conditions

$$\frac{Q_{T_2}}{Q_{T_1}} = \frac{T_2}{T_1} \quad \text{and} \quad Q_T = S.T.$$

These two equations are neither mathematically nor physically equivalent. Only the first expression by " quasi-permanent " equilibrium conditions (at the absolute zero) can give a value for $Q_T = 0$. The second equation includes the " permanent " equilibrium conditions whereby only approximately $T \cong 0$ and the entropy $S = S_{max.}$, and therefore $Q_T \neq 0$. These conditions can only be considered as practicable at the zero point. The usual method of use of the fundamental laws of thermodynamics is also possible for zero-point conditions. The general thermodynamical standpoint combined with the low-temperature phenomena (including absolute zero) can be used for the theoretical discussion of the question if a few very natural assumptions are made. The paper deals with these assumptions and concludes that his argument outlined above is justified. S. G. B.

978. Thermodynamic Equilibrium and Reciprocal Effects in the New Gas Theory. W. Bothe. *ZS. f. Phys.* **46. 5–6.** *pp.* **327–334, 1928.**

The new hypotheses on the statistics of ideal gases which Pauli, Fermi and Dirac have formulated has already had far-reaching consequences. The paper discusses their application and effect on the laws of interaction or reciprocal working of molecules, atoms and electrons with each other and with light quanta. The mass-effect law is developed in such a form that it is valid for the Bose, Einstein and Fermi gases. The paper is theoretical throughout. S. G. B.

979. Thermodynamics of Mixtures. V. Fischer. *ZS. f. Phys.* 46. 5–6. *pp.* 427–443, 1927.

A mathematical and theoretical treatment for the development of a general expression for the different types of concentration and equilibrium conditions of a mixture of two constituents. From the results obtained an expression is deduced and applied for the heat content and entropy of mixtures. It is applied to the case of gold-copper alloys. Finally, the case of mixtures of three constituents is discussed, and the equilibrium conditions are determined theoretically. S. G. B.

980. The Triangular Reversible Cycle Applied to Several Classes of Thermodynamic Relations. C. Raveau. *Comptes Rendus,* 185. *pp.* 1265–1267, *Dec.* 5, 1927.

Deals with a large number of different problems, including among isothermal cycles the case of an electric battery with e.m.f. E, which undergoes three successive modifications which can be represented on the plane of pv and on that of Em by triangles, the sum of the two areas, which measures the total work, mechanical and electrical, being zero, since the cycle is supposed to be reversible. The general equation for such a case is $(dp_1dv_2 - dp_2dv_1) - (dE_1dm_2 - dE_2dm_1) = 0$, and by omitting either one of the products or a product in each of the binomials all the possible relations are obtained. In general, the author concludes that the triangular cycle should be chosen as the ultimate element in thermodynamic reasoning. Its properties are expressed by assuming that the sum of certain binomials, one of which is miltiplied by Carnot's function, and which contain only differentials, without derivatives, is zero. In a single equation all the formulæ can be read, which can be derived from one another by permutations. H. N. A.

981. Thermodynamic Integrating Factors. A. Press. *Phil. Mag.* 4. *pp.* 1245–1249, *Dec.,* 1927.

The integrating factor $\mu = 1/\theta$ leads for a so-called perfect gas to the equation of state $pv = R\theta$, but the author shows that to obtain the characteristic equation for the adiabatic expansion of a perfect gas μ must be equal to

$$\mu_0 \frac{\epsilon^{\frac{\beta}{1-\gamma}v^{1-\gamma}}}{v^{1-\gamma}} \cdot \epsilon^{a\theta}.$$

It follows necessarily that to each particular thermodynamic path there corresponds an integrating factor, which does not necessarily satisfy the relation $\mu = 1/\theta$. H. N. A.

SOUND.

982. Experimental Acoustics. F. Trendelenburg. *Zeitschr. f. tech. Phys.* 8. 11. *pp.* 502–506, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

An account of experiments on the clearness of sound as depending on the balance set up between outgoing and reflected waves in large buildings. The chief observations were made in the Cologne cathedral. J. J. S.

983. Resonances of a Violin. Florence M. Chambers. *Phil. Mag.* 5. *pp.* 160–166, *Jan.*, 1927.

A method of finding the resonance pitches of a violin is described. Some of these correspond to the natural frequencies of the air enclosed in the violin; the others are taken to correspond to the natural frequencies of the body. The results of the harmonic analysis of a number of the vibration photos taken at different pitches for the same point of the wire support the view that the resonances found are functions of the violin itself. It is evident that there is a large number of resonance pitches on a violin which do not correspond to a wolf-note. The wolf-note on the "wolfy" violin agrees in pitch with one of the resonances found. AUTHOR.

984. Violin Sounds. H. Backhaus. *Zeitschr. f. tech. Phys.* 8. 11. *pp.* 509–515, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

Records the sounds produced by various violins by means of a high-pitched oscillograph, a condenser microphone and a five-step low-frequency amplifier. Frequencies are recorded up to 8000. The quality of the violin notes is governed by the resonances of the instrument, and these resonances are mapped out for various specimens. The author finds that, generally speaking, the better violins have a decided resonance between 3000 and 4000 and not between 2000 and 3000. The higher resonance is characteristic of the vowel sound "ee," and it may not be an accident that most names for the violin in various languages contain that vowel sound. The diagram illustrating the resonances of a Stradivarius fiddle shows the chief resonance at 3600, together with minor resonances at 4900, 1800, 1050, 500, 400 and 200. More recent Italian instruments tend to show a resonance in the less favourable region 2200. Some modern makes are distinctly superior in this respect. It is possible that frequencies above 8000 may turn out to be of importance to the quality of the sound.

E. E. F. d'A.

985. Recording Sonometer. E. Gerlach. *Zeitschr. f. tech. Phys.* 8. 11. *pp.* 515–519, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

Sounds of musical frequency are best generated by superimposing the currents of two high-frequency generators. The beat current is received in a loud speaker which transmits the sound to an aluminium ribbon microphone. The microphone current is amplified and communicated to a photographic recorder. The recorder is mechanically linked to the condenser which governs the frequency of the loud speaker, so that, when the latter goes through the scale of frequencies, the loudness of each corresponding note is automatically entered on the frequency scale of the photographs. Thus a curve is obtained showing the efficiency of the loud speaker for the various musical frequencies. By a modification of this method the author records the spatial distribution of the sound. The method can be used for determining the efficiency of microphones, amplifiers, selection circuits, gramophone recorders, and the absorption and reflection of sound. E. E. F. d'A.

986. Acoustic Transformers. H. Nukiyama and K. Kobayashi. *Tohoku Univ., Technol. Reports*, 7. 1. *pp.* 33–48, 1927.

The system, which consists of an elastic medium confined by two surfaces which can be independently displaced, is called an acoustic transformer. The authors give a mathematical theory of such a transformer, and show that it is analogous to an electrical circuit containing two inductances in series with a condenser attached to the junction. In order to check the theory of the acoustic transformer experimentally, they construct a coupled system of two mechanical impedances by using the diaphragm of a telephone receiver and an orifice which face each other across an air chamber, and determine every constant of both impedances by measuring the motional impedance of the telephone receiver and check these constants obtained by theoretical calculations. They conclude that both the primary stiffness and the ratio of transformation, by which the performance of the acoustic transformer is determined, calculated as mentioned above, can be used in the actual loading conditions of the acoustic transformer. The performance of the acoustic transformer with high primary stiffness and high ratio of transformation is important and interesting in the practical field of sound radiation and measurement of acoustic impedance.

E. E. F. d'A.

987. Vibration of Organ Pipes Closed by Thin Walls. P. Cermak. *Phys. Zeits.* 28. *pp.* 701–707, *Nov.* 1, 1927.

The notes given by closed pipes with thin end walls are determined experimentally. It is found that the end walls take part in the vibration, produce displacement of the nodes, and thus alter the frequency as compared with firmly closed pipes. The fundamental note of the tube is in general lowered, and the more, the thinner the end wall, the less its density and the less its resilience. The remaining partials are usually raised. When the end walls are sufficiently thin partials of the open pipe usually occur. The frequencies of the end walls do not necessarily agree with the frequencies of the partials heard, as may be proved by placing the diaphragm of a telephone connected to an amplifier near the end wall. E. E. F. d'A.

988. Consequences of a Matrix Mechanics and a Radiating Harmonic Oscillator without the Quantum Postulate. A. Press. *Phil. Mag.* 4. *pp.* 1249–1261, *Dec.*, 1927.

The problem of the harmonic oscillator is treated on purely classical lines by the method of matrices, without reference to the quantum theory. An equation is obtained which shows, as a consequence of applying Hamilton's canonical equations, that an unexcited harmonic oscillator caused to radiate by an impressed field of force only does so when it can absorb and re-radiate a definite quantum of energy equal to one-third of its normal unexcited content. The example of an organ pipe is quoted, which does not give an appreciable increase in volume of sound with increased blowing pressure, but suddenly changes its frequency. H. N. A.

989. The Accuracy of the Monochord as a Measurer of Frequency. G. E. Allan. *Phil. Mag.* 4. *pp.* 1324–1337, *Dec.*, 1927.

Taylor's formula for the monochord does not allow for the "rigidity" of the wire. Various forms of correction have been proposed, and the author has examined the question experimentally. He arrives at the following formula for the correction for a steel wire: $\log \delta n = 3 \cdot 274 + 2 \cdot 391 \log n + 2 \cdot 070 \log \rho_1 - 1 \cdot 366 \log T$, where n is the vibration frequency, ρ_1 the linear density and T the tension. Using Taylor's formula alone, the error δn may exceed 4 %, but with increased tension it can be reduced to zero. The correction is not important when low frequencies are measured with a thin wire under high tension, if allowance is made for the change in ρ_1 with T. With higher frequencies the wire breaks before the error is reduced to unity. H. N. A.

990. Chemical Effects of High-Frequency Sound Waves. I. Preliminary Survey. W. T. Richards and A. L. Loomis. *Am. Chem. Soc.*, *J.* 49. *pp.* 3086–3100, *Dec.*, 1927.

Three possible chemical effects of sound waves of great intensity produced in high-frequency fields [see Abstract 3165 (1927)] might be expected: (1) At points of rarefaction in the standing waves, cavitation and similar phenomena involving the formation of a vapour phase; (2) in the compressed regions of the standing waves an increase in the kinetic energy density corresponding with a local rise in temperature capable of affecting the rate of a reaction; (3) the effect of the vibration frequency of the sound wave itself on an unstable molecule, apart from its local kinetic effect on molecules collectively.

Experiment shows that these sound waves (1) exert an explosive effect on superheated liquids, such as carbon tetrachloride; (2) "atomise" substances at a liquid or gaseous interface, giving, for instance, an aqueous emulsion of mercury able to reduce potassium permanganate and to persist for several days; (3) produce bubbles of vapour in air-free liquids at about 1° below their boiling point; (4) expel dissolved gases from water; (5) accelerate certain chemical reactions. T. H. P.

991. Rational Musical Scales in the Web of Fifths and Thirds. J. Würschmidt. *ZS. f. Phys.* 46. 7–8. *pp.* 526–557, 1928.

If a table is made by recording from a given starting key steps taken upwards in perfect fifths, these being written from left to right, and upward steps of major thirds, written from the notes of the first series upwards, a tone-field is formed which is called a web of fifths and thirds (Quinten-Terzengewebe) which may stretch out indefinitely in the two directions mentioned. A section of this web is formed, starting from key D. The scale used is logarithmic, in which the octave is represented by 30,103, the fifth by 17,609, etc. Certain principles are set forth which underlie the tone systems obtained, the first of these being that all intervals less than an octave are formed by steps consisting of fifths or of thirds, or a combination of fifths and thirds. Tones which lie outside the octave are included by stepping up or down an octave. Confining the web of fifths (f) and thirds (t) to $11f \times 27t$, the author derives ten tone-systems or scales, which are compatible with the principles laid down. These contain respectively 5, 7, 10, 12, 19, 22, 31, 34, 53 and 118 intervals to the octave. The 19-step gamut is the most probable extension of the present 12-note scale. [See Abstract 897 (1921).] G. E. A.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

992. Evaluation of Electromagnetic Fields. M. J. O. Strutt. *ZS. f. Phys.* 45. 9–10. *pp*. 625–631, 1927.

It is pointed out that the evaluation of electromagnetic fields in any space is in general reduced to a variation problem and to an integral equation. The formulæ are explained in the light of the skin effect. The paper is, however, far too mathematical to lend itself to useful abstraction. J. K.

993. Theory of the "Ampérien." R. Ferrier. *R.G.E.* 22. *pp*. 1159–1164, *Dec.* 31, 1927.

This paper gives in a concise form the considerations which have led the author to introduce a new physical quantity, the ampérien, into electromagnetic theory. The ampérien arises naturally in an attempt to reconcile the laws of electrodynamics with autonomous dynamics, in which the notion of absolute time is conserved. This account is submitted as a *mise au point* of the ideas of the author. W. S. S.

994. Calculation of the Magnetic Field due to a Current. J. Koenigsberger. *Phys. Zeits.* 2–8. *pp*. 814–815, *Dec.* 1, 1927.

Some corrections to a previous paper by the same author [see Abstract 2585 (1927)]. G. E. B.

995. The Magnetic Field due to a Spatial Current induced by a Linear Current Source. H. Jensen. *Phys. Zeits.* 28. *pp*. 815–819, *Dec.* 1, 1927.

The magnetic field due to a spatial current is known [see Abstract 2585 (1927)], and from this is determined the field at the surface of an indefinitely large plane homogeneous isotropic plate due to the induced current; limiting conditions then give the field due to a surface current from a point source, and also the field due to a current from an indefinitely long linear electrode. Two special cases occur: (1) If the ratio of plate thickness h to the distance a of the plate from the source is much less than unity, $H = 2\pi J\lambda[1 - h/2\lambda a]/a$, where J is the current and λ a factor. In the limit where $h = 0$, the expression $H = 2\pi J\lambda/a$ holds for a point electrode. (2) If the ratio is greater than 1 : 0·7. G. E. B.

996. Indeterminateness of Electrical Charge. C. Snow. *Bureau of Standards, Sci. Papers, No.* 566. *pp*. 547–556, 1927.

Granting the existence of a true magnetic charge of density ρ_2, moving with velocity u_2, and satisfying curl $e + \dot{h} = - \rho_2 u_2$ and div $h = \rho_2$, no experimental method would lead to its detection provided ρ_2 is everywhere in a fixed ratio to ρ_1, the density of the electrical charge. In particular the electron to which the ordinary theory attributes an electric charge ϵ may be regarded as a particle of electric and magnetic charges ϵ' and λ respectively, with $\epsilon = \sqrt{\epsilon'^2 + \lambda^2}$, again provided that for all protons the ratio of true electric to true magnetic charge is ϵ/λ. The indeterminateness here emphasised is shown to persist in the world geometry developed by Eddington. W. S. S.

997. Existence of an Electrification due to Friction between Solid Bodies and Gases. Part I. M. A. Schirmann. *ZS. f. Phys.* 46. 3–4. *pp.* 209–236, 1927.

Experiments are described which throw light on the mode of production of electrification when a stream of mercury vapour is shot through a glass tube. The apparatus consists virtually of a mercury-vapour jet pump. The electrification causes a luminous discharge which can be photographed. Two frictional effects are differentiated: (*a*) rubbing of condensed drops of mercury on the glass, and (*b*) rubbing of the vapour itself on the glass. The former alone is active for low velocities of the mercury-vapour stream. At higher velocities the disposition of the luminosity in the apparatus shows definitely the existence of the latter effect. Measurements of the decay period of the luminosity were also made. It is suggested that at the surface of a solid an electrical double layer is formed of which at least the outer layer lies in the film of gas or moisture adhering to the surface, and can be mechanically disrupted by the "rubbing" of a gas. W. S. S.

998. Electrification by Friction between Solids and Gases. E. Perucca. *ZS. f. Phys.* 46. 9–10. *pp.* 747–752, 1928.

A previous paper [see Abstract 143 (1926)] gave an account of a series of researches the results of which were interpreted as an instance of electrification by friction between solids and gases. Güntherschulze's criticisms, and especially his objection that the observed phenomenon is due to a simple voltaic effect caused by minute drops of mercury, induced the author to repeat his investigations with an apparatus differing only slightly from that previously used, but so modified as to exclude the formation of such drops. The result of these renewed experiments is, briefly, a confirmation of his previous conclusions. An illustration of the modified apparatus is given. E. F.

999. Variation of Cosmic Radiation with Sidereal Time. K. Büttner. *ZS. f. Phys.* 45. 7–8. *pp.* 588–600, 1927.

At heights of 2800 metres and over, a daily period of ionisation is found to occur in closed vessels, and three principal maxima have been observed. The observations were made on the Zugspitze, near Munich, with two ionisation chambers, from 1st to 12th March, and the ionisation-time graphs exhibit maxima at 5, 14 and 21 o'clock, Middle-European time. The author concludes that mountain observations certainly indicate that there is, for cosmic radiation, a daily period which is dependent on sidereal time, and that observations taken at sea-level are for rather than against this conclusion. [See also Abstracts 1098 (1924) and 935, 936 (1926).]
G. E. A.

DISCHARGE AND OSCILLATIONS.

1000. Circular Spark on the Dielectric Plate. Y. Ikeda, T. Itoh and S. Kojima. *Hokkaido Imp. Univ., Mem.* 1. *pp.* 105–112, *and pp.* 113–126, *Dec.*, 1927. *In English.*

A peculiar form of spark figure has been previously described by the present authors. The first of these papers contains a description of the method of producing the circular sparks and shows by photographs the real dependence on the thickness of the dielectric plate. It is found that when the spark takes a circular form, and when the thickness of the dielectric plate is given, the diameter of the circular spark depends only on the p.d. between the electrodes. In the second paper, which is by **T. Itoh**, the following are the main points considered: Circular spark by reduced pressure; discharge figure at more reduced pressure; the effect of the frequency of the primary current; effect of the series spark-gap in producing the circular spark; experiments with sealing-wax; circular spark with various substances and relations between the circle and other physical constants. A. E. G.

1001. Moving Striations in Discharge Tubes. R. Whiddington. *Frank. Inst., J.* 203. *pp.* 707–712, *Dec.*, 1927.

It is well known that the current through a Geissler discharge tube, even when maintained by a battery of steady storage cells, may under certain circumstances be unsteady, even regularly intermittent. The conditions governing this intermittence have apparently never been understood or even reproducible. In the case of neon, Aston and Kikuchi noticed a visible irregular intermittence in a rotating mirror which they attributed in some way to sound waves travelling down the tube. The present experiments deal in the main with the luminous discharge through argon. It is found that when the discharge is passing in the tube and the argon is fairly pure, the so-called uniform positive column is the main feature, and it is this type of discharge which is here investigated between pressures of about 0·1 to 2 or 3 mm. Hg. A. E. G.

1002. Discontinuous Discharge through Rarefied Gases. R. Anthouard. *J. de Physique et le Radium*, 8. *pp.* 522–528, *Dec.*, 1927.

A study is made of the conditions under which a periodically discontinuous discharge may be obtained in a rarefied gas and also of the character of such a discharge. Perkins [see Abstract 1280 (1909)] has given a theory which explains the observed phenomena, and in the present paper experimental results are given in agreement with Perkins' formulæ for (*a*) the time of charge and (*b*) the discharge current. Experimental data are also given showing the effect of various parameters on the discharge, such as the pressure of the gas and the distance apart of the electrodes. [See also Abstract 2969 (1927).] A. W.

1003. Electric Discharge in Gases at Low Pressures. I. Langmuir. *ZS. f. Phys.* 46. 3–4. *pp.* 271–299, 1927.

A theory of the electric discharge in gases at low pressure is developed and tested by a series of potential measurements. Further, the velocity distribution of the carriers of the charge is measured and found to correspond to Maxwell's law. From this it appears that electron temperatures may rise to about 80,000°. Hence it is shown that Maxwell's velocity distribution in a beam of initially homogeneous velocity leads to a much shorter free path than is to be expected from the kinetic theory, and different possibilities for explaining this surprising result are discussed. A. W.

1004. Ionisation of HCl by Electron Impacts. H. A. Barton. *Phys. Rev.* 30. *pp.* 614–633, *Nov.*, 1927.

For the purpose of supporting the Born crystal grating theory the assumption has been generally made that the observed ionisation potential of HCl was a measure of the amount of energy required to split an HCl molecule into an H^+ and a Cl^- ion. Recent indirect experiments have cast doubt on the correctness of this assumption. The work here described was undertaken to determine with the aid of a mass spectrograph the actual products of electron impact ionisation in HCl. To be certain no H^+ ions are produced by impacts with HCl molecules, and also to establish the identity of the $(HCl)^+$ ions, a new apparatus is built. The Cl^+ ions and the hydrogen ions are observed to decrease in number relative to the $(HCl)^+$ ions with time after each evacuation in the same manner as the $(H_2O)^+$ ions decrease. It is concluded that the water vapour coming off the walls is in some way responsible for these ions, probably aiding the production of molecular hydrogen at the filament. It is found in experiments with negative ions that Cl^- ions are formed in numbers relatively large, chiefly near the filament. They do not require impacts of more than 3 volts for their formation, if they require impacts at all. There seems to be no connection between the Cl^- ions and the 13·8-volt ionisation potential. The results all point to the conclusion that $W + HCl \rightarrow (HCl)^+ + e$ is the process by which electron impacts ionise the gas, and that the process $W + HCl \rightarrow H^+ + Cl^-$ does not occur. A general discussion of the breakdown of molecules is given. A. E. G.

1005. Thermionic Work Function of Tungsten. C. Davisson and L. H. Germer. *Phys. Rev.* 30. *pp.* 634–638, *Nov.*, 1927.

Dushman, Rowe, Ewald and Kidner [see Abstract 1717 (1925)] pointed out that in reducing the data of their measurements on the thermionic work function of tungsten the present authors failed to correct the value obtained from the temperature variation of emission for the so-called "Schottky effect"—that is, for the reduction of the work function by the external electric field at the surface of the filament. This is here done for tungsten. For zero field at the filament the value found for thermodynamic ϕ is 4·82 volts, and, as before, the value 4·91 volts is found as the equivalent voltage of the work function measured calorimetrically at 2270° K. Careful consideration shows that the difference of 0·09 volt between these quantities must be interpreted as evidence that conduction electrons within the filament do not possess normal thermal energies, and that no evidence is offered by this experiment regarding the surface heat of charging. A. E. G.

1006. Methods of Measuring Ionic Mobilities in Gases. M. Laporte. *Ann. de Physique*, 8. *pp.* 710–745, *Dec.*, 1927.

This paper undertakes a critical study of the different methods employed in measuring the mobilities of ions in gases. It is shown that the experimental results which have been so far obtained are not in opposition when the existence of a curve of distribution of mobilities, as set forth in a recent paper by the author [see Abstract 715 (1928)], is taken into consideration. A. E. G.

1007. Absorption of Potassium Ions in Various Gases. F. M. Durbin. *Phys. Rev.* 30. *pp.* 844–847, *Dec.*, 1927.

Loss by scattering, retardation or neutralisation suffered by a beam of positive potassium ions in traversing helium, argon, hydrogen, nitrogen, air and oxygen.—The absorption of potassium ions accelerated by 8·5 to

350 volts has been measured in helium, argon, hydrogen, nitrogen, air and oxygen. A magnetic deflection apparatus was used in which the metal parts were entirely enclosed in glass. The rays were observed that traversed a fixed distance at various pressures without being deflected from a semicircular path by scattering, retardation, or neutralisation. A free path for absorption may be deduced which varies with the gas and velocity of the ions; it is larger than the value given by the kinetic theory for an argon atom in the gases used, varying from ten times in the case of fast rays in helium to 1·4 times for slow rays in oxygen. At low velocity the free path decreases rapidly and approaches the kinetic theory value.

AUTHOR.

1008. Post-Arc Conductivity and Metastable States in Mercury. M. L. Pool. *Phys. Rev.* 30. *pp.* 848–863, *Dec.*, 1927.

A mercury arc, excited between an anode and a Wehnelt kathode, was interrupted by a relay run by a rotating commutator. By means of a second relay run by the same commutator galvanometric current measurements could be made at any instant before or after the arc was interrupted. Residual positive ions and electrons formed during the arc have been found to remain in measurable quantities under certain conditions for 1/10 sec. after the arc has been turned off. These ions and electrons cannot be rapidly removed from the arc space by the application of potentials to collecting electrodes because there are formed about the electrodes space charge sheaths which effectively restrict the potentials applied to a small region. The thickness of these space charge sheaths about both the anode and kathode gradually increase with time, and finally fill the entire arc space, whereupon the post-arc current ceases. For ion concentrations from 10^{12} to about 10^{7} the decay of the post-arc current is closely exponential for all voltages and for various forms of collecting electrodes. For concentrations below 10^{7} the decay becomes much more rapid. The critical restriking potential, previously attributed to the existence of long-lived metastable atoms, is accounted for by the distorted electrical fields which are set up in the neighbourhood of the filament as a result of electron diffusion from a region of high electron and positive ion concentration. The location of this region in the arc space is markedly dependent upon the filament temperature. The critical re-striking potential is most sharply defined for low filament temperatures and for heavy arc currents. Kathode-ray oscillograph curves show that impurities do not effect the critical potential.

AUTHOR.

1009. Ionisation Efficiency of Ultra-Violet Light in Cæsium Vapour. E. M. Little. *Phys. Rev.* 30. *pp.* 963–964, *Dec.*, 1927.

Corrections to the original paper [see Abstract 3182 (1927)].

1010. The Mean Life Duration of Light Ions and the Ionisation Balance over Land and Sea. V. F. Hess. *Phys. Zeits.* 28. *pp.* 882–894, *Dec.* 15, 1927.

Some of the principal results obtained from these experiments, some of which have been carried out over the sea and others over land, are as follows: The usual quadratic law of reunion does not hold good for normal air containing nuclei, but as Schweidler has shown [see Abstract 1462 (1925)], there is the following linear relation between the ionisation strength, q, and the number, n, of light moving ions per c.c., $q = \beta \cdot n$.

β is called the vanishing constant of light ions; its reciprocal, ϑ, represents the mean life duration of these ions. For experiments carried out at Heligoland the value of β over the land is $44 \cdot 9 \times 10^{-3}$ sec.$^{-1}$, and over the harbour $35 \cdot 3 \times 10^{-3}$ sec.$^{-1}$, the corresponding values of ϑ being $22 \cdot 3$ sec. and $28 \cdot 3$ sec. The values of the vanishing constant and number of nuclei are greatest with land wind. From values given it appears that in pure land air the mean life duration of ions is no smaller than in pure sea air. A. E. G.

1011. Scattering of Canal Rays through Hydrogen. G. P. Thomson. *ZS. f. Phys.* 46. 1–2. *pp.* 93–105, 1927.

The scattering of hydrogen canal rays is investigated by means of a thermopile. It is found that the alteration of scattering with the angle is in good accord with that given in earlier experiments when the photographic method was used, so that the reliability of the present method may be considered as established. The Conrad results [see Abstracts 439 (1927)] and 2365 (1927)] are discussed and the possible explanation of them given. The form of the bundles of rays, which is made homogeneous by means of an electric and magnetic field, is especially considered. [See also Abstract 1496 (1927).] A. E. G.

1012. Experiments on Electron Reflection *in Vacuo*. D. Brown. *Leeds Philosoph. and Lit. Soc., Proc.* 1. *pp.* 187–190, *Dec.*, 1927.

An account is here given of an investigation into the energy of low-speed electrons after reflection from metallic, and from hot and cold oxide surfaces. The results suggest that, whereas a glowing oxide surface behaves like an ordinary good conductor, the cold surface by reason of its semi-insulating character becomes electrically charged. The charge may be a positive one, although the bombardment is by negative electrons, if the average electron ejects more than one secondary electron. [See also Abstract 2120 (1927).] A. E. G.

1013. Number of Impacts Associated with the Diffusion of Slow Electrons in an Electric Field. W. Harries and G. Hertz. *ZS. f. Phys.* 46. 3–4. *pp.* 177–187, 1927.

The number of impacts of slow electrons in a rare gas, calculated with reference to the number of electrons captured by the collecting plate, is shown to be dependent only very slightly upon the strength of the field employed although the number of these electrons depends very largely upon the strength of the electric field. Diffusion in a field-free cylindrical condenser and the Ramsauer effect are also discussed. [See also Abstract 2139 (1925) and *Phys. Zeits.* 26. *pp.* 868–870, *Nov.* 15, 1925.] J. S. G. T.

1014. Effect of Slight Impurities on the Excitation Voltage of the Rare Gases. F. M. Penning. *ZS. f. Phys.* 46. 5–6. *pp.* 335–348, 1928.

The effect of admixture of very small quantities of mercury and argon on the excitation potential of neon was investigated quantitatively. The effect of such admixture was a marked reduction in the excitation voltage. The explanation of this effect is to be attributed to ionisation of the foreign atoms by the metastable atom of neon. The necessary condition for this effect, that $V_i < V_m$ (where V_i is the ionisation potential of the foreign gas and V_m is the energy of the metastable condition of the gas in question), was investigated for neon, argon and helium as principal gases and various other gases as impurities The condition was established for these gases. The effect of impurities, for which $V_i < V_m$, is nearly always to lower the excitation potential. The only exception found to this rule was that of argon with NO as impurity. A. W.

1015. Exit Work of Glow Discharge Electrons. A. Smekal. *ZS. f. Phys.* 46. 5–6. *pp.* 451–452, 1927.

Michel has recently upheld that the exit work of the electrons from oxide kathodes follows the equation $\Delta\phi \,.\, b^2 =$ constant, and not Schottky's approximate equation $\Delta\phi \,.\, b =$ constant, b in both cases being the distance between neighbouring metal atoms. The author points out that Espe's results do not support this view, and criticises Michel on the ground that he has taken for b the dimensions of the oxide lattice, and not that of the metal lattice. [See next Abstract.] H. N. A.

1016. Reply to A. Smekal's Note on the Exit Work of Glow Discharge Electrons. G. Michel. *ZS. f. Phys.* 46. 5–6. *pp.* 453–454, 1927.

Espe rejected a value of Δd obtained with CaO, since he considers values obtained with thick layers as being useless on account of the possible formation of " islands." These, however, are just as probable with thin layers as with thick ones, and none seem to have been observed in the experiments with thick layers in question. Points out dangers in using thin layers, and does not consider Espe's results as being definite from the quantitative point of view. Considers that the metal in the active surface layer does not form a continuous metallic skin over the surface of the oxide, so that the distance between atoms is the same as in the metal lattice; but rather that it is made up of free metallic and oxygen atoms adsorbed on the surface of the oxide in closest packing. Sommerfeld has obtained a formula by considering the photo effect which agrees with the author's. [See preceding Abstract.] H. N. A.

1017. Physical Significance of Glow-Electron Emission. A. v. Hippel. *ZS. f. Phys.* 46. 9–10. *pp.* 716–724, 1928.

It is claimed that the theory here put forward seems to have certain advantages over those previously propounded. It succeeds in developing the emission equation in a form which does not disagree with experience, without uncontrollable assumptions on the behaviour of conducting electrons. The validity of the equation is not restricted to the solid phase; the dependence on temperature of the work of emission and of the basis constants is given. The work of emission is brought into connection with the polarisibility of the atom, and so the work of emission can be determined. [See also Abstract 780 (1925).] A. E. G.

1018. Some Extensions of Theory and Measurements of Shot-Effect in Periodic Circuits. H. B. Vincent. *Nat. Acad. Sci., Proc.* 13. *pp.* 774–785, *Nov.* 15, 1927.

Some additions are made to the method discussed in a previous paper [see Abstract 1485 (1927)] for computing the effect in a periodic circuit of the probability fluctuations of the anode current in a vacuum tube. A mechanical integrator is described which greatly improves the accuracy of the method. Measurements made lead to values of the electronic charge of the order $1\cdot70\ 10^{-19}$ coulomb, which is rather greater than the

accepted value (1·59 10^{-19}), although the total error is estimated at less than 2 %. Measurements of the shot-effect at different anode currents showed a slight diminution in the ratio of observed fluctuation to calculated fluctuation as the anode current increased from 1 to 5 milliamperes.
W. S. S.

1019. Relation between Anode Current and Potential deduced from the Orbital Motion of the Electrons. L. E. McCarty. *Phys. Rev.* 30. *pp.* 878–892, *Dec.*, 1927.

An expression for the anode current in terms of the grid and anode potentials and the geometrical dimensions of a parallel plate type of valve is deduced from the orbital motion of the electrons. The following simplifying assumptions are made: The grid is assumed to consist of small parallel wires of infinite length situated between two infinite parallel plates at distances from it comparable with the distance between consecutive grid wires, and the vacuum is assumed to be high enough to ensure that the mean free path of the electrons is large in comparison with the distance between the plates. The effect of the space charge is neglected. The case of the negatively charged grid is considered in greater detail than that of the positively charged grid.
A. W.

1020. Resonance of Residual Rays and the Shortest Hertzian Waves. M. A. Lewitsky. *Phys. Zeits.* 28. *pp.* 821–825, *Dec.* 1, 1927.

Liebisch and Rubens discovered for $CaCO_3$ residual rays of 28–30, 4 μ and 94 μ, and the present author in his experiments with very small Hertz oscillators obtained the wave-lengths 32 μ and 92 μ. A. A. Glagolewa-Arkadiewa has established Hertz waves of 81, 8 μ and 90 μ. It therefore appears natural to endeavour to bring together these regions. Work has already been done in this connection by Rubens as far back as 1896, but it is considered of value to repeat Rubens' experiments in the light of up-to-date knowledge. This is done in the present paper.
A. E. G.

1021. Continuous Whistling produced by a Piezoelectric Quartz Emitting Simultaneously Two Oscillations of High-Frequency. F. Bedeau and J. de Mare. *Comptes Rendus,* 185. *pp.* 1591–1593, *Dec.* 27, 1927.

Hund's arrangement for exciting a piezoelectric quartz consists in intercalating a condenser, between the armatures of which is put the crystal, in the circuit of a triode; the plate circuit comprises an oscillating circuit of self-induction L and capacity C. On giving L a suitable value the quartz vibrates in general at one, and one only, of three fundamental frequencies, f_1, f_2, or f_3: f_1 is the frequency of vibration along the axis perpendicular to the optic and electric axes, f_2 the frequency along the optical axis, and f_3 the frequency along the electric axis. Usually $f_1 < f_2 < f_3$. When the crystal is not placed symmetrically in relation to the armatures of the condenser, with many specimens of quartz critical values C_1' and C_2' of C may be obtained. When C is comprised between C_1' and C_2' the following phenomena may be observed: (1) The quartz emits a continuous whistling; (2) the curve representing the current I as function of C presents a bend more or less accentuated between C_1' and C_2'; (3) the oscillations of high frequency being suitably received, a whole series of chromatic scales may be shown. It appears that for the values of C between C_1' and C_2' the quartz emits simultaneously two vibrations of high frequency. One is the frequency f_3 and the other one of the uneven harmonics of the frequency f_1. J. J. S.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1022. Current Distribution in Supraconductors. F. B. Silsbee. *Bureau of Standards, Sci. Papers,* No. 556. [22 *pp.*], *Aug.* 4, 1927.

H. K. Onnes found that when certain metals are cooled down to very low temperatures at a certain critical temperature (T_c) there is an abrupt change in the rate of decrease of resistivity and within a temperature range of a few hundredths of a degree the resistivity drops to less than 10^{-12} times its value at 0° C. If the temperature is maintained constant at a point somewhat lower than the critical temperature while the current through the specimen is gradually increased, the normal resistance of the specimen reappears suddenly at a certain " threshold " value of current (I_c). The lower the temperature the greater I_c. Further, it has been found that if the specimen is placed in a magnetic field which is gradually increased in intensity, the normal resistance reappears at a certain critical value (H_c) of the magnetic field. The author suggested that the " critical current " and " critical magnetic field " are not independent phenomena, but that the threshold value of current is that at which the magnetic field due to the current itself is equal to the critical magnetic field. Since this suggestion was made in 1917 much experimental work has been done by K. Onnes and his associates, and in particular two experiments have been made in which the specimen consists of a slender tube of tin which is influenced by the magnetic field both of the current flowing in the tin itself and of the current flowing in a separate wire placed along the axis of the tube. As a result of these and other experiments Onnes and Tuyn accepted the hypothesis of Silsbee stated above as a correct one. The latter in this paper gives a more detailed analysis of the experimental work than had been carried out by the experimenters themselves, and thus subjects his hypothesis to a more definite and quantitative test. The theoretical results obtained by this more detailed analysis when compared with the observed data support the hypothesis referred to. J. J. S.

1023. Motion of the Conducting Electrons in Metals. W. Braunbek. *Phys. Zeits.* 28. *pp.* 803–805, *Nov.* 15, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The author has considered the motion of electrons in metals from the side of its relation to the crystal lattice and the assumed change of place occurring in this. With external field F and for current density j he has found the following relation: $j = \frac{e}{\tau a^2} \cdot W_T \cdot \frac{2aeF}{E_T}$, where a is the lattice interval, τ the specific time of vibration of the ions in the lattice, and thus $1/\tau a^2$ the number of the ions which would pass in a second through 1 sq. cm. if each ion in each vibration made a change of position. W_T is the probability (dependent on temperature) of a change of place, so that $\frac{1}{\tau a^2} \cdot W_T$ is the number of actual changes of place per sq. cm. per sec., and $\frac{e}{\tau a^2} \cdot W_T$ the charge transported thereby. Without external field this charge flows equally self-diffused in all directions. With the application of the external field F a direction in the proportion $2aeF/E_T$ is determined.

This fraction is twice the ratio of the potential energy of field aeF with a jump of a to the thermal energy E_T of the ion. If $W_T = 1$ and if E_T has the classic value 3HT, then $j = 2e^2F/3\tau a$KT and the conductivity $\sigma = 2e^2/3\tau a$KT. While this hypothesis does not remove the difficulties which exist when either the classic theory or the quantum theory is applied, it shows at least that similar results follow when the case is considered either from the point of view of the electron lattice or from the viewpoint of the electron gas. J. J. S.

1024. Electrical and Thermal Conductivities of Metals as a Problem of the Free Path. G. Borelius. *Ann. d. Physik*, **84.** 7. *pp.* 907–914, *Dec.* 23, 1927.

The experimental data on the thermal and electrical conductivities of metals may be systematised by means of the idea of the free path. The conception may also be applied to interpret the results of Grüneisen and Goens [see Abstract 3196 (1927)]. Assuming (1) the expression for the electrical conductivity contains the free path as a factor; (2) in a pure unhardened monocrystal the free path is limited by the heat movement in the lattice; (3) in an impure metal an additional limitation to the free path is caused; (4) in hardened metals the free path is limited by disturbances in the lattice (such as plane slippage), the author develops certain equations. Combining these with Grüneisen and Goens' results he draws conclusions as follows: (1) Free movement of electrons is interrupted by atoms of impurities; (2) the Wiedemann-Franz-Lorenz law is explained; (3) at low temperatures the movement of electrons does not affect energy transformations. Finally, the connection with Sommerfeld's modification of the Drude-Lorenz electron-gas theory is discussed. T. B.

1025. Temperature Variation of the Electrical Conductivity of Crystals. N. Ussataja and B. Hochberg. *ZS. f. Phys.* **46.** 1–2. *pp.* 88–92, 1927.

For $NaNO_3$, CaF_2, and NaCl the electrical conductivity decreases regularly with increasing temperature, and the constants are practically equal. For mica the conductivity diminishes much more slowly. A. C. M.

1026. Investigation of Metallic Crystals. Part VI. Temperature Law of Heat Resistance for Regular Metals. E. Grüneisen. *ZS. f. Phys.* **46.** 3–4. *pp.* 151–159, 1927.

Considers further the measurements described by Grüneisen and Goens in Part V [see Abstract 3196 (1927)], together with measurements made by W. Meissner of the specific electrical resistance at − 252° C. of the purest specimen of copper employed by the author. The formulæ adopted represent in an extraordinarily satisfactory manner the results obtained with test pieces of Al, Cu and Au of different purity and hardening. The drop in the electrical and thermal resistances at low temperatures, however, point to the fact that with the method of representing the facts used by the author, which makes use of a Debye atomic heat function, a value of this function Θ which increases as the temperature gives better results than a constant value. H. N. A.

1027. Electrical Conductivity of Palladium in a High Vacuum and in Different Gases. A. Puodžiukynas. *ZS. f. Phys.* **46.** 3–4. *pp.* 253–270, 1927.

In this paper the resistance of chemically pure palladium wire has been investigated for high vacua and changes in resistance when the wire is charged with hydrogen [see Abstract 445 (1918)] and nitrogen. Without recourse to heating, the hydrogen charged palladium wire gave off very much gas in the high vacuum and, when placed again in an atmosphere of hydrogen, the wire reabsorbed over 1400 volumes of hydrogen, its electrical resistance increasing 2·02 fold. The degassed wire was inactive towards nitrogen, but was rendered active by being recharged with hydrogen and subjected to a very gradual degassing in high vacuum without heating. By this means the wire was found to absorb 285 volumes of nitrogen and its resistance to be increased 1·22 fold. After degassing, the respective resistances decreased again. It is concluded that the solution of gaseous atoms in metals will always increase the electrical resistance. Full experimental details are included in the paper. H. H. Ho.

1028. Theory of Detectors and Coherers. Dubar. *Comptes Rendus*, 185. *pp.* 1023–1024, *Nov.* 14, 1927.

Pélabon has shown that an electric current can pass through an insulating interval separating two conductors if the thickness is sufficiently small, but the conductivity of this arrangement differs according to the direction of the current. The electronic theory indicates that the current will pass from the conductor poorer in electrons to the conductor richer more easily than in the opposite direction. The author formed by electrolysis a very thin skin of silica on the surface of a block of silicon and applied under strong pressure some graphite in contact with this skin. The surface concerned was 3 sq. cm. in area. The current-e.m.f. curve of the complex conductor thus formed is dissymmetrical and shows a point of inflection to the origin corresponding to a resistance of 12 ohms. With the same applied e.m.f. of 3·25 volts the current is 1·4 amperes in the direction silicon-graphite and 0·4 ampere in the opposite direction. J. J. S.

1029. Hall Effect in Aluminium Crystals. P. Jones. *Phil. Mag.* 4. *pp.* 1312–1322, *Dec.*, 1927.

The Hall coefficient has been determined for eight specimens of single and aggregate crystals of aluminium for a current of 3·923 amperes and for magnetic fields ranging from 5724 to 8414 gauss. The coefficient is independent of (i) crystal size and (ii) orientation of the lattice planes in the crystal with respect to the primary current, and the absolute value is $3 \cdot 44 \times 10^{-4}$. W. H. Ge.

1030. Hall Effect in Bismuth with Low Magnetic Fields. P. H. Craig. *Phys. Rev.* 30. *pp.* 964–965, *Dec.*, 1927.

Corrections to the original paper. [See Abstract 2182 (1926).]

1031. Conduction of Electricity and Dielectric Strength of Ion Crystals. A. Smekal. *Zeitschr. f. tech. Phys.* 8. 12. *pp.* 561–586, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The nature of the electricity carriers in crystalline, non-metallic conductors is considered, and it is shown that, as regards dependency of the conductivity on the temperature and strength of field, ionic and electronic conductors exhibit concordant behaviour, but impurities, diminution of the granule size, and moulding raise the conductivity of ions and lower that of electrons. Comparison with the electronic conductivity of metals gives an indication regarding the nature of the mechanism of conduction.

Of predominating importance for the conductivity of the ion crystals is the number of mobile electricity carriers. A new general formula which has been derived for the dependence of the conductivity on the temperature indicates that, for ordinary temperatures at least, the pore structure alone determines the creation of electricity-carriers capable of migration. The conducting character of an ion crystal is determined solely by those carriers which, in the pore structure region, require the least work to liberate them. The occurrence of partial electronic conduction depends always on the instability of multivalent anions in the porous region. A definite conclusion concerning the nature of the crystal lattice linking is not possible from a knowledge of the character of the conduction. Increase of the conductivity with increase in the strength of field is effected by depression of the work of liberation of the electricity-carriers, this being accompanied by gradual alteration in the number of pore-ions utilisable for conduction of the current. [See also Abstract 455 (1926.] T. H. P.

1032. Photoelectric Conductivity of Sulphur. B. Kurrelmeyer. *Phys. Rev.* 30. *pp.* 893–910, *Dec.*, 1927.

The primary current is proportional to the electric field from 20 to beyond 15,000 volts per cm. If there is a saturation voltage, it is probably higher than 50,000 volts per cm. Light produces charges with and without the aid of the field. No evidences of secondary current were found. The current is proportional to the intensity of illumination over the range investigated, about 100 to 1, and for all kinds of light. The photocurrent referred to unit incident energy is measured from 420 to 650 $m\mu$; its maximum lies at 470 $m\mu$. The optical absorption is measured over the same range; it is large below 500 $m\mu$, and complete in the violet. In the region between 500 and 650 $m\mu$ it has some unusual features. From the measured absorption values the photocurrents referred to unit absorbed energy are calculated. Formally at least, the quantum-equivalent law is not obeyed. A possible explanation is offered in terms of the peculiarities of the absorption curve. Currents in different directions in the crystal are equal in absolute magnitude, but exhibit a curious unipolarity along one direction, that of the acute bisector of the optic axes, with components along other directions. The reverse currents exhibit parallel differences. The results suggest that sulphur has a polar axis due to atomic asymmetries and should show the piezoelectric and pyroelectric effects. E. E. F. d'A.

1033. Residual Thermoelectric Phenomena in Apparently Homogeneous Wire. T. Terada, T. Isutsui and M. Tamano. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 122. *pp.* 201–235, *Nov.* 17, 1927. *In English.*

The investigations described were undertaken with the intention of testing if the so-called Benedicks effect may also be observed in the case of an apparently homogeneous wire of nearly uniform section subjected to an asymmetric temperature gradient, thus avoiding the possible effect of the geometrical form which may play some part in cases of the " Drosselkreuz " method. It was found that a considerable e.m.f. may be produced by heating a small portion of wire symmetrically. The magnitude of this effect is so great as to eclipse the Benedicks effect even if it coexists with it. The e.m.f. got by symmetrical heating shows a quasi-periodic fluctuation along the length of wire. Similar effects were observed with wires of Ni, Cu, Al, Ag, and W. The effect seems to be related to the rate of variation of the diameter of the wire. The effect of annealing on the general fluctuation of the effect is small, though the grain size of microcrystals is considerably changed. Thus the effect is not due to the initial heterogeneous strain. The effects of quenching, etching, polishing, coating and mechanically straining were studied. From the observations made it is suggested that the effect noticed is due to the natural fluctuation in the average orientation of microcrystals in successive elementary portions along the wire. The apparent relation to geometrical form is indirect. Some tentative calculations applying the suggested theory seem to favour the hypothesis stated. J. J. S.

1034. Thermoelectric Effect in Single-Crystal Bismuth. R. W. Boydston. *Phys. Rev.* 30. *pp.* 911–921, *Dec.*, 1927.

Data are presented on the thermal e.m.f. against constantan of nine single-crystal wires of bismuth, of which the inclinations of the vertical axis, with respect to the wire axis, range from 23° to 83·5°. The temperature interval is from − 182° to about 300° C. Some of the observed results are also referred to copper for the sake of comparison with results of previous workers. Data are also given on the thermal e.m.f. of liquid bismuth against various crystal orientations. The thermoelectric power, and Peltier heat, computed from the e.m.f.-temperature curves in the usual fashion, agree well with the Voigt-Thomson symmetry relation for temperatures above 0° C., but depart somewhat, though in no consistent fashion, from this relation for temperatures below 0° C. From the data are computed the Peltier heat and the difference in the Thomson coefficients for $\mathrm{Bi}_{\perp}$ against $\mathrm{Bi}_{\parallel}$. The location of certain maxima and minima in these curves are found not to occur in the region of rapid decline of atomic heat, though Grüneisen and Goens have found such a coincidence for Zn and Cd. The thermal e.m.f. of polycrystalline specimens of both bismuth and zinc when determined experimentally agree surprisingly well with the result predicted by Linder's formula. AUTHOR.

1035. Polarity and Piezoelectric Properties. A. Hettich and A. Schleede. *ZS. f. Phys.* 46. 1–2. *pp.* 147–148, 1927.

The method of Giebe and Scheibe [see Abstract 2594 (1925)] for investigating the piezoelectric properties of crystal splinters, and in particular of pentaerythrite, gives no information as to the polarity of the tetragonal principal axis of that substance. The method only shows whether the substance under investigation belongs to a class with or without a centre of symmetry. The negative results for the barium nitrate group indicate that they belong to a symmetrical class, as can be inferred from the space lattice. [See Abstract 2367 (1923).] A. W.

1036. Mechanical and Electrical Stability and Molecular Forces. A. Joffé. *Phys. Zeits.* 28. *pp.* 911–916, *Dec.* 15, 1927.

A practical and theoretical discussion of the breakdown potentials in insulators and their relation to the cohesive and chemical forces in the materials. It is shown that there is a possibility, in solid bodies, to impose electric fields which would almost equal in strength the chemical and cohesive forces in the body itself. Dielectric constants, elasticity, Stark effect and surface tensions were investigated in these fields and a new method for installation of insulators, condensers, etc., can be based on the results recorded. S. G. B.

1037. Effects of Surface Layers on Mica Insulation. J. M. Macaulay. *Roy. Techn. Coll., Glasgow, J. No.* 4. *pp.* 5–13, *Dec.*, 1927.

Reference is made to a curious phenomenon noted by the late Lord Rayleigh, namely, that a freshly split mica surface becomes a fairly good conductor of electricity and recovers its insulating properties on exposure to the air. Experiments are described and curves obtained which show this effect in ordinary room air, in air as clean and dry as the designed apparatus will give, and in air from an air compressor. It is found that (*a*) the insulation always collapses at once even when the air is dried and cleaned as described ; (*b*) slow recovery takes place in this atmosphere ; (*c*) a partially recovered surface in such a (closed) atmosphere collapses in a few minutes if room air is admitted ; (*d*) partial recovery of the surface in condition (*c*) can be again effected by a chemical drying agent ; (*e*) the rate of recovery after splitting in a dried and cleaned atmosphere depends on the volume of air brought up to the surface ; and (*f*) the duration of the applied voltage temporarily hastens the recovery of a split surface. Based on Rayleigh's explanation, a general explanation of the results is suggested on the hypothesis that liquid air layers can form on the freshly formed surfaces. AUTHOR.

1038. Dielectric Constants of Aqueous Electrolyte Solutions. H. Zahn. *Phys. Zeits.* 28. *pp.* 916–918, *Dec.* 15, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

Some recent measurements are discussed and new measurements given. A brief polemical discussion follows. A. D.

1039. Measurement of the Dielectric Constants of Liquids with High Fields by a New Method. J. Malsch. *Ann. d. Physik*, 84. 7. *pp.* 841–879, *Dec.* 23, 1927.

The determination of the dielectric constant with high fields is important in connection with the Debye dipole theory. The method adopted uses the discharge current of a condenser through an inductance and through resistances with which condensers are connected in parallel, one of which is adjustable and is used as a standard, while the other contains as dielectric the liquid investigated. Measurements of the currents are obtained by means of a bolometric arrangement previously described, and in this way the capacity of the condenser containing the liquid is determined and the dielectric constant measured. Spark lengths up to 5 mm. and in some cases up to 11 mm. were employed in the discharge, giving field intensities of at least 100,000 volts per cm. No alteration of the dielectric constant with the field intensity could be observed. The method can be used with liquids which have considerable conductivity. Water, glycerine and ethyl ether have been investigated. H. N. A.

1040. Dielectric Constants of Binary Mixtures. Part V. Electric Moments of Certain Organic Molecules in Carbon Disulphide and Hexane Solution. J. W. Williams and E. F. Ogg. *Am. Chem. Soc., J.* 50. *pp.* 94–101, *Jan.*, 1928.

The value of the electric moment for solute molecules, calculated from dielectric constant and density data in various non-polar solvents, is quite independent of the solvent used. The present paper shows that benzene, carbon disulphide and hexane may be used successfully for this purpose. By means of an electrical resonance method previously described [see

Abstract 2946 (1926)] dielectric constant data are given for CS_2 solutions of benzoic acid, phenol cinnamic acid, iodine, naphthalene, anthracene, benzene, hexane, nitrobenzene and chlorobenzene and for hexane solutions of benzoic acid, naphthalene benzene, nitrobenzene and chlorobenzene. Density determinations have also been made and the whole are given in a series of tables. It is shown that the electric moments of benzene, carbon disulphide and hexane are practically zero, *i.e.*, they are non-polar in nature. The results for benzene are in accord with those of Sanger, determined otherwise. The electrical moment of naphthalene has chemical significance ($\mu = 0\cdot70 \times 10^{-18}$). The conventional method of writing its formula gives a symmetrical molecule and would seemingly have zero moment. The above result is significant in that it is known that the second benzene ring in naphthalene behaves differently from the first. Tables of electric moments are appended. S. G. B.

1041. Arrangement of the Electrometer Method for Measuring the Dielectric Constants of Electrolytes. A. P. Carman and C. C. Schmidt. *Phys. Rev.* 30. *pp.* 922–924, *Dec.*, 1927.

The electrometer method described by A. P. Carman [see Abstract 418 (1925)] has been modified to meet difficulties of heating effects, of buoyance, of electrolytic polarisation and of exact measurement of potential differences between the fixed plates and the needle plates. The method is particularly adapted to the measurement of the relative dielectric constants of water and aqueous electrolytes, even where the concentrations and resulting conductivity of the electrolytes are considerable. AUTHORS.

1042. Dielectric Constants of Four Electrolytes as Given by the Carman Electrometer Method. C. C. Schmidt. *Phys. Rev.* 30. *pp.* 925–930, *Dec.*, 1927.

The electrometer method devised by A. P. Carman [see preceding Abstract] is used to measure the dielectric constants of aqueous solutions of NaCl, KCl, $BaCl_2$ and $CuSO_4$. Curves showing the relation between dielectric constant and concentration of the solution are obtained for each of these four substances, up to an equivalent normal concentration of 0·018 for NaCl, of 0·01 for KCl, of 0·024 for $BaCl_2$, and of 0·028 for $CuSO_4$. These curves each show first a decrease of the dielectric constant with increasing concentration. After passing through a minimum, the dielectric constant increases with the concentration, rising in each case to a value greater than that of water. For solutions of $BaCl_2$ and $CuSO_4$ there is in each case a second minimum in the rising branch of the curve. These experimental results for the dielectric constants of aqueous electrolytes can be explained by an hypothesis in accordance with the general dipole theory of Debye, as interpreted by Walden, Ulich and Werner. AUTHOR.

1043. A Liquid Resistance. A. Gyemant. *Zeitschr. f. tech. Phys.* 8. 11. *pp.* 491–493, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The solution of a strong electrolyte in a mixture of two organic solution media of differing dielectric constants gives a resistance of large value which may be varied within wide limits. The validity of Ohm's law, the dependence of the resistance on the dielectric constant of the solvent and the temperature coefficient are discussed. As examples of its employment there were dealt with: Measurement of ionisation currents, use in Nernst's bridge as comparison resistance, and in the technical use of high tension as a distributor of e.m.f. In various experiments a mixture of benzene and ethyl alcohol was employed, as these could be obtained in a high degree of purity. Resistance values between 10^4 and 10^{12} ohms can be thus obtained. J. J. S.

1044. A Mechanical Harmonic Analyser for Kathode-Ray Oscillograms. C. F. Wiebusch. *J.O.S.A. and R.S.I.* 15. *pp.* 355–358, *Dec.*, 1927.

A mechanical harmonic analyser is described which will analyse oscillograms obtained from the kathode-ray oscillograph when the reference field is sinusoidal. The instrument is adjustable to take care of oscillograms of various sizes. The analyser can be used also for curves plotted on a uniform base. The particular instrument described was made to analyse up to and including the tenth harmonic. AUTHOR.

1045. Power Factor and Capacity of the Electrodes and Base of Triode Valves, with Special Reference to their Use in Thermionic Voltmeters. G. W. Sutton. *Phys. Soc., Proc.* 40. *pp.* 14–21; *Disc.*, 21–22, *Dec.*, 1927.

Discusses the conditions under which a three-electrode-valve voltmeter should be operated to ensure a minimum power consumption and at the same time to give indications closely proportional to the square of the input voltage. A simple method of adjusting the operating voltages to fulfil the necessary conditions is described. AUTHOR.

1046. Power Factor of High-Frequency Electric Furnaces. R. Dufour. *J. de Physique et le Radium*, 8. *pp.* 508–521, *Dec.*, 1927.

After making certain simplifying assumptions, calculations are made of the power factor of a high-frequency electric furnace operated on the spark system. The time of the condenser charge is first calculated, then the number of charges per second and the intensity of the current, and finally the power factor. The calculations are illustrated by numerical values for a particular system. A. W.

1047. Absolute Measurements of Capacitance by Maxwell's Method. H. L. Curtis and C. Moon. *Bureau of Standards, Sci. Papers, No.* 564. *pp.* 487–531, 1927.

An expression is derived for capacitance obtained by using a Maxwell bridge. The various assumptions made in the theory are stated and the errors arising in a failure to meet them are discussed. The theory of the galvanometer used in the bridge is investigated, and the effects of (1) magnetic material in the galvanometer coil, and (2) galvanometer current on the magnetic field are examined. The design required for the galvanometer to integrate the current correctly is explained, while the theory of the bridge when this does not occur exactly is set out. The method employed requires that a condenser shall be charged and discharged at a known rate. Two types of apparatus for charging and discharging exist: (1) a tuning fork, which has a more constant rate and an accurate setting of the bridge; and (2) a rotating commutator, which has a higher rate of charge and discharge. The speed of the former can be found by reference to a pendulum of known rate and of the latter from a standard chronometer. Full details are given of the experimental method and of detailed tests with it. The errors in the method do not amount to more than 2 to 3 parts in 10^5. R. S. R.

ALTERNATING CURRENTS AND MAGNETISM.

1048. Eddy Currents in an Elliptical Cylinder. M. J. O. Strutt. *Ann. d. Physik*, 84. 4. *pp.* 485–506, *Nov.* 2, 1927.

The case considered is that of a very long cylindrical conductor of elliptical cross-section placed in an alternating longitudinal electric field or in a longitudinal magnetic alternating field. These two cases correspond to current displacement and magnetic field displacement respectively. The paper is chiefly mathematical, and for simplicity the external alternating field is assumed to be homogeneous. This is approximately the case if the wave-length in the ether of the electromagnetic vibration is large compared with the cross-section of the cylinder. The electrical field may be obtained by causing an alternating e.m.f. to act on two conducting plates between which the conductor is stretched. For the magnetic case the conductor may be placed in a magnetising coil traversed by an alternating current. The little-known Mathieu's functions are employed for the mathematical solution of the problem. J. J. S.

1049. Current Displacement in Cylindrical Conductors. F. Noether. *Ann. d. Physik*, 84. 6. *pp.* 775–778, *Dec.* 3, 1927.

A mathematical treatment of the general case where the cross-section is of any shape. J. J. S.

1050. Vector Diagrams for Current Resonance. E. Roessler. *E.N.T.* 4. *pp.* 525–533, *Dec.*, 1927. *From the Telegraphentechn. Reichsamt.*

The general case of current resonance is dealt with. This is complicated, and the general formulæ are not simple. For the practically important cases, however, extraordinarily simple relations can be established. The vector diagram of the apparent resistance as a function of the frequency is a circle and the current diagram a straight line. J. J. S.

1051. Frequency Demultipliers. Rouelle. *Comptes Rendus*, 185. *pp.* 1450–1452, *Dec.* 19, 1927.

The maintenance of sub-harmonics in oscillatory circuits containing iron-cored inductances [see Abstract 1461 (1926)] is investigated in terms of the change of *régime* necessary to initiate them. A. Wh.

1052. Paramagnetic Rotation of Plane of Polarisation. R. Ladenburg. *ZS. f. Phys.* 46. 3–4. *pp.* 168–176, 1927.

The theory outlined in a former paper [see Abstract 612 (1926)] has been improved upon in several respects by C. G. Darwin and J. Frenkel, and this is discussed. By quantitative reasoning the conditions are investigated under which this new paramagnetic effect outweighs the usual diamagnetic effect, and why it is not observable in the absorption lines of gases. The observations of J. Becquerel and his co-workers on the properties of crystals of the rare earths at low temperatures are discussed, since they exhibit all the characteristics of the paramagnetic rotation. A. C. M.

1053. Magnetic Behaviour of Ozone. O. R. Wulf. *Nat. Acad. Sci., Proc.* 13. *pp.* 744–748, *Nov.* 15, 1927.

Both Becquerel and Schumeister (1881) considered ozone to be more paramagnetic than oxygen. This seems improbable as the ozone molecule is supposed to have no odd electrons. Applying the method of Gouy, the author suspends a cylindrical armature, 20 cm. long, 8 mm. diameter, vertically from a balance in such a way that only the lower end of the cylinder is directly between the pole pieces. The armature is within a glass cylinder through which oxygen or ozone (6 %) is passing upward. The armature was of pyrex glass or soda glass, the former diamagnetic, the latter slightly more paramagnetic than oxygen. The ozone is certainly not highly paramagnetic, rather diamagnetic, but a definite value cannot be given. H. B.

1054. Magnetostriction of Iron, Nickel, Cobalt and their Alloys. A. Schulze. *Zeitschr. f. tech. Phys.* 8. 11. *pp.* 495–502, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The change in the length of ferromagnetic bodies accompanying their magnetisation is measured at ordinary temperature by fixing the movable plate of a condenser to the end of a rod of the material, 33 cm. long, 6 mm. diameter, and observing the change in the capacity by heterodyning with the aid of a Zickner differential condenser. Pure iron expands in fields of up to 70 gauss; the dilatation then decreases, crosses zero at 230 gauss and becomes negative. Nickel contracts more and more as the field intensity is increased; alloys of the two metals may expand or contract. The 15 alloys tested were prepared with 1 or 2 % Mn to facilitate machining. The curves of magnetostriction have two expansion maxima, separated by a zero value for 30 % Ni (non-magnetic alloy). Near 80 % Ni the curves once more cross the zero line, and the striction becomes negative; both the maxima and minima are the higher, the stronger the field. Permalloy (78 % Ni), which is very sensitive in its high permeability to mechanical stress, shows no magnetostriction, and the magnetostriction is, in the reversible region, independent of the thermal treatment. According to Arnold and Elmen, permalloy should slowly be cooled from 900° to 600°; according to Gumlich, rapid cooling is nearly as good. Thus the high initial permeability of permalloy does not seem to be directly connected with the magnetostriction, while magnetostriction and field intensity (especially the true internal field intensity) go together in their variations. Cobalt itself does not change in weak fields, but contracts in stronger fields. In alloys containing 10 and 20 % Fe the cobalt contraction still predominates; with 30 % Fe dilatation sets in and rises to more than double the value it has in Fe-Ni alloys. The curves plotting $\Delta l/l$ against concentration show the same peaks as electric conductivity, temperature coefficient of resistance and thermal expansion. Alloys of cobalt, nickel show in fields of up to 350 gauss the contraction of the two constituent metals; in stronger fields dilatation seems to set in. Cast cobalt behaves, according to Honda, opposite to cast iron; it contracts in weak fields and expands in strong fields. The magnetostriction curves of the alloys show the peaks of the other curves suggesting the existence of definite compounds. [See also Abstract 203 (1928).] H. B.

1055. Wiedemann Effect. E. Fromy. *Ann. de Physique*, 8. *pp.* 626–709, *Dec.*, 1927.

The paper opens with an historical summary of work on the effect. Then follows a theoretical discussion, starting from the consideration of simple magnetostriction. The case of a tube submitted to a helicoidal field gives the Wiedemann effect in which the tube suffers torsion. Expressions are obtained for the angle of torsion per unit length of the tube for various fields and also for the couple to prevent this torsion. The torsion can be calculated for a thin tube, but not for a thick one, although in this case the couple can be evaluated. This latter quantity is used in the experimental study, alternating current being used to produce a periodic couple in resonance with the free vibrations of the tube so that the sensitiveness is greatly increased. The next part of the paper is a study of the connection between the Wiedemann effect and the intensity of longitudinal magnetisation. Similar curves are obtained for these quantities in terms of longitudinal field and axial current. There are likewise corresponding critical points for each quantity for the same value of the inducing field. It is concluded that the effect is not an independent phenomenon, but a particular case of magnetostriction. F. S.

1056. Land Magnetic and Electric Observations, 1918–1926. H. W. Fisk and H. U. Sverdrup. *Dept. of Terr. Mag. Researches,* 6. [524 *pp*.], *Oct.*, 1927.

1057. Annual Report of the Director of the Department of Terrestrial Magnetism. *Carnegie Inst. of Washington, Reprint from Year Book No.* 26. *pp.* 165–213, 1926–1927.

1058. Periodic Variations in Terrestrial Magnetism. K. F. Wasserfall. *Terr. Mag. Geofysiske Publ.* 5. 3. [33 *pp*.], 1927.

The daily means of horizontal intensity (H) at the Polar station Gjoahavn were employed because the characteristic features often observed in the variation of magnetic elements stood out exceptionally well. The station is very close to the magnetic pole, and H is thus very small. A comparison was also made between the magnetic and the meteorological elements, the temperature records (T) at Gjoahavn and Oslo being used. Variations of H and T were compared with the solar activity, Wolfer's relative figures R for sunspots for the year in question being employed. The results were further extended in time by the use of the monthly means of H at Potsdam. The separate curves were examined by the Cock-Blankford method. Among the periods established were: (1) 3·3 days for H and T at Gjoahavn, a period in agreement with Abbot's solar activity period; (2) a sporadic tendency for a period of 10–11 days; (3) 28·3 days for H and 28·0 days for T in comparison with a sunspot period of 27·3 days; this gave an oscillation of 22·7 for H and 4·7° C. for T; (4) 41 and 70 days, probably due to the 10- and 14-day periods; (5) from the Potsdam records, periods of 70 days and 6 and 8 months. The author considers it may be possible to use the periods in the temperature records to forecast the temperature distribution in the ensuing season and gives results obtained in this way. R. S. R.

1059. Electric Methods of Measurement of the Earth's Magnetic Field and a Universal Induction Magnetometer. W. Uljanin. *Zeitschr. f. tech. Phys.* 8. 11. *pp.* 493–495, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

A description of the author's electric magnetometer and compensation magnetometer. J. J. S.

1060. Periodicities of Magnetic Storms and Seismic Disturbances in the Sun. E. Belot. *Comptes Rendus,* 185. *pp.* 1259–1261, *Dec.* 5, 1927.

An explanation is given of the primary and secondary periodicities of magnetic storms described by Deslandres. The primary periodicity represents regions of equatorial activity on the sun regularly distributed at intervals of 60°. The secondary periodicities represent intermediate regularities. If any disturbance sets up a wave of great amplitude and propagated with a velocity of 1800 metres/sec., which is considered quite reasonable for the deep layers of the sun, the wave will emerge at two points about 120° apart. Disturbances due to symmetry at the antipodes make the hexagonal structure complete. A. Wh.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

1061. Effects of Radiation on Patients and Radiologists, and on Protection. H. Rolleston. *Brit. J. of Radiology,* 23. *pp.* 266–290; *Disc.,* 290–291, *Oct.,* 1927. *Mackenzie-Davidson Memorial Lecture.*

The lecture is divided into a number of sections, some of which are summarised as: (1) The position of radiologists in the medical profession, (2) the physical effects of radiations on patients. Some of the physical effects are described and theories of the minor and major injuries observed are given. It is concluded that on the whole the evidence is against the notion of a stimulating action of small doses of X-rays. (3) The method of action of radiations on malignant growth. So far as experiments on animals go, the conclusion appears to be justified that the beneficial results from radiations are due to the reaction induced in the normal tissues and not to any effects of the radiations on the cancer cells. In the present state of knowledge it is safer to keep an open mind on the mechanism of the local effects of radiations on malignant tumours and, while attaching full weight to the influence of the radiations on the connective tissue and bloodvessels in the malignant cells, not to deny that radiations, especially those of radium, may directly damage the malignant cells. (4) The question of radio sensitiveness is complicated by the variations in sensitiveness during different stages of the life of the cell and numerous other factors. The physical effects of long-continued work in radiological departments on those thus engaged. (5) A description of blood changes induced by X-rays and radium. The genesis of the X-ray Protection Committee is given and the general difficulties in setting up universal standards are discussed. The paper closes with a section on idiosyncrasies and a lengthy bibliography. W. V. M.

1062. Analysis of Some Observations on the Action of X-Rays on Drosophila Eggs. J. A. Crowther. *Brit. J. of Radiology,* 23. *pp.* 292–297; *Disc.,* 297–299, *Oct.,* 1927.

A mathematical analysis of results due to Packard (*Journ. Cancer Res. vol.* 10. *p.* 319, 1926) assuming a chance distribution of " hits " of X-ray quanta on cells. The form of the survival curve of Drosophila eggs may be calculated from probability considerations. W. V. M.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

1063. Heat of Adsorption of Oxygen on Charcoal. A. F. H. Ward and E. K. Rideal. *Chem. Soc., J. pp.* 3117–3128, *Dec.*, 1927.

A series of experiments were made on four different types of charcoal to determine the adsorption of oxygen and the heat of adsorption, the rate of auto-oxidation, the area of methylene-blue adsorption, the ash content, the true and apparent bulk densities, and the particle size. The high initial heats of adsorption have been determined, and the areas of the corresponding active patches were found to be proportional to the rates of auto-oxidation of the charcoals. The covering power of oxygen has been compared with that of amyl alcohol and shown to be of the same order and to have a constant ratio for all charcoals. In all cases of a charcoal with a high ash content, an instability of the carbon surface and a very high initial heat of adsorption of oxygen were found. F. J. B.

1064. Adsorption by Coconut Charcoal from Binary Mixtures of Saturated Vapours. The Systems Methyl Alcohol-Benzene, Ethyl Alcohol-Benzene, Propyl Alcohol-Benzene, and N-Butyl Alcohol-Benzene. F. G. Tryhorn and W. F. Wyatt. *Faraday Soc., Trans.* 24. *pp.* 36–47, *Jan.*, 1928.

In a previous paper the authors have described the adsorption of binary saturated vapours by charcoal, and showed that the process took place in three well-defined stages [see Abstract 2466 (1926)]. The further investigation confirmed the existence of the three stages. The adsorption of binary vapour systems of benzene and methyl, ethyl, *n*-propyl, and *n*-butyl alcohols at 20° C. was measured. The three stages were confirmed, the first mainly diffusional, the second selective, and the third capillary condensation in the intergranular spaces. A possible quantum mechanism involving energy transfers in the infra-red region is suggested for these effects. F. J. B.

1065. Adsorption and Langmuir's Residual Valency. M. N. Chakravarti and N. R. Dhar. *Kolloid Zeits.* 43. *pp.* 377–386, *Dec.*, 1927. *Translation.*

When a fraction $1 - \Theta$ of a surface is covered by another substance (an electrolyte) and the rate of evaporation of the adsorbed substance is $K(1 - \Theta)^n$, then the following relation between the quantity adsorbed a in equivalents and the adsorption maximum A, corresponding to complete covering, can be deduced from Langmuir's theory of residual valency: $a/A = p^{1/n}/(1 + p^{1/n})$, where $p = \alpha\mu/K$, μ is the number of the molecular impacts, and α is the adsorption coefficient, *i.e.*, the fraction of molecules retained. The factors to be considered are chemical, kinetic and electric surface charges. With relatively strong adsorptions, ions of three valencies should be more adsorbed than ions of two valencies, and the latter more than univalent ions. Foreign substances (a second electrolyte) should decrease the adsorption the more, the less the former is adsorbed; there should be an adsorption maximum, and the formula should become logarithmic for low concentrations. The experiments made with silver nitrate and copper chloride adsorbed by manganese dioxide (precipitated or colloidal), and with the adsorption of the ions Cl′

(from KCl), C_2O_4'' (from $K_2C_2O_4$), PO_4''' (from Na_2HPO_4) and $Fe(CN)_6''''$ (from $K_4Fe(CN)_6$, by the hydroxides of iron, aluminium and chromium gave values in good accord with the calculations. [See also Abstract 1905 (1927).] H. B.

1066. Theory of the Viscosimetry of Colloidal Solutions. Wo. Ostwald. *Kolloid Zeits.* 43. *pp.* 190–209, *Nov.*, 1927.

A critical review of recent work, with special regard to the merits of the capillary apparatus and the concentric cylinder (Couette, 1891) apparatus and to Hatschek [see Abstract 2999 (1927) and Freundlich and Dannenberg [see Abstract 1281 (1926)]. The capillary viscosimeter had been charged with two defects, a vertical and a horizontal error. The former, due to the fact that the hydrostatic pressure varies during the measurement, has been avoided in the recent apparatus of the author and R. Auerbach. The latter, more serious error concerns the velocity gradient (or stream profile) in a cross-section which, for laminar flow in the sense of classical hydrodynamics, is variable (parabolic) in the capillary and nearly constant in the Couette. But sols do not behave like normal liquids in stream-line flow, which would be incompatible with the dependence of the viscosity upon the shear gradient; according to Reiner and Riwlin [see Abstract 527 (1928)], laminar flow is not shown by certain elastic liquids of variable shear either. The colloidal particles influence one another and the disperse medium. Viscosity cannot be referred to hypothetical gradients, but must be referred to measured mean velocities. Sols, however, show in addition to the ordinary turbulence at higher velocities a special structural turbulence which does not conform to the rules of Osborne Reynolds and Blasius. H. B.

1067. Viscosity Anomalies observed in Couette Apparatus. Wo. Ostwald. *Kolloid Zeits.* 43. *pp.* 210–214, *Nov.*, 1927.

Certain viscosity anomalies, observed in the Couette apparatus, have not been observed in the author's capillary viscosimeter. The viscosity curves of gelatine sols are, in the Couette, not the same for rising as for falling angular velocity (hysteresis), while the viscosity always increases with the duration of the shear, independent of the angular velocity. In the capillary viscosimeter the viscosity always decreases with time. The reason is, according to the author, that in the Couette the inner stationary cylindrical (metal) surface remains for relatively long times in contact with the sol which is adsorbed, the adsorption having the effect of increased surface roughness. This effect would be smaller in the glass capillary and with quicker tests. Similar but more complex viscosity changes take place in the Couette apparatus with starch sols [Hatschek and Jane, *ibid.* 38. *p.* 36, 1926] and in ammonium oleate [see Abstract 2999 (1927)] and have been ascribed to a progressive breakdown of the sol structure under shear stress. The author suggests loss of structural viscosity by turbulence and the spreading of the vortices in the limit layer (Prandtl) through the annular space between the two cylinders. H. B.

1068. Influence of Hydrolysed Gelatine on the Precipitation of Silver Chromate. T. R. Bolam and B. N. Desal. *Faraday Soc., Trans.* 24. *pp.* 50–52, *Jan.*, 1928.

Gelatine has the power of retarding the separation of silver chromate from aqueous mixtures of silver nitrate and potassium chromate. A series of measurements were made to determine the inhibitive influence of gelatine which was hydrolysed. Mixtures of 1/100 *N* silver nitrate and potassium chromate in equal volumes, each mixed with a 3 % solution of gelatine, were prepared. The mixtures were placed in a thermostat at 25° C., and the time required for the appearance of a definite red colour was taken as a measure of the inhibition. The results showed that the hydrolysed gelatine precipitated uniformly in all parts, and the mixture became a clear red. Unhydrolysed gelatine precipitated locally became turbid red, and the precipitate settled more rapidly than with hydrolysed gelatine. F. J. B.

1069. Solvation of the Disperse Phase in Jellies. H. Gaunt and F. L. Usher. *Faraday Soc., Trans.* 24. *pp.* 32–36, *Jan.*, 1928.

The authors endeavoured to secure direct evidence for or against solvation by measuring the change in concentration of an indifferent solute caused by the gelatinised silicic acid. A solution of water-glass was poured into an excess of acid solution containing the reference substance; the quantities and composition of the liquids were so arranged that the resulting mixture remained homogeneous and liquid for a sufficiently long time to allow a sample to be taken, weighed and diluted. Gelatinisation took place in from 2 to 36 hours. The results failed to support the hypothesis of the chemical chain in the cases examined.

F. J. B.

1070. Dimensional Distribution in Reversible Polydisperse Systems. N. and E. v. Raschevsky. *ZS. f. Phys.* 46. 3–4. *pp.* 300–304, 1927.

In this paper a polydisperse system is treated as a mixture of monodisperse systems. Application of the Planck theory of dilute solutions to such a mixture and a search for the extreme limits of the characteristic function thereby obtained give an expression for the distribution function of the particle dimensions. [See also Abstract 1687 (1926).]

H. H. Ho.

1071. Symmetry of Molecules in the Dissolved State. K. Weissenberg. *Phys. Zeits.* 28. *pp.* 829–834, *Dec.* 1, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The classical stereochemistry of vant' Hoff assumed that the molecules of organic substances in the dissolved state showed tetrahedral symmetry, if of the type C_{a4} (*e.g.*, methane derivatives with four equal substitution groups), and that only compounds of the type $C_{\alpha\beta\gamma\delta}$ (with four different groups and with asymmetrical carbon) should differ from their enantiomorphs, all the others showing the symmetry of the images from fixed or rotating mirrors. These rules, which had proved useful for the preparation of amorphous phases, had been found not to hold for crystals, nor for vapours and solutions. Thus substituted molecules of the type C_{a4} showed dipole character in benzene solutions at extreme dilution, and could, therefore, not have tetrahedral symmetry, because with such a configuration the centres of the positive and the negative charges would coincide, and dipole moments would be impossible. With a pyramidal molecular structure, on the other hand, the centres would be separate. The C-atom of a C_{a4} compound could, therefore, not occupy the central position in a regular tetrahedron, but should lie eccentrically at the apex of the pyramid. The other rule, that crystallisation in two different mirror-image forms indicated an asymmetrical carbon atom in structure, likewise failed in the case of sixty organic compounds tabulated. If the classical views were also abandoned with respect to amorphous phases, the stereochemistry of dissolved molecules could in general be reduced to a purely geometrical symmetry rule as advocated by the author and by Schoenflies. H. B.

1072. Osmotic Pressures of Concentrated Solutions. W. D. Bancroft and H. L. Davis. *J. Phys. Chem.* 32. *pp.* 1–43, *Jan.*, 1928.

The connection between osmotic pressure and vapour pressure is discussed. Two equations are developed for the relation between osmotic pressures and vapour pressures, in a manner analogous to vant' Hoff. It is shown that no equation of the form $PV = RT$ can express the osmotic pressures accurately, and that the heat of dilution corresponds to a work term which prevents any form of $PV = RT$ having a validity over a range of concentrations. The equation must be $PV = RT + f(Q)$, where $f(Q)$ is a function which cannot be evaluated at present. A method for finding the volumes of the components of a solution in a solution is given and extended to the calculation of the specific volume of the solvent. Osmotic pressures of ideal solutions of benzene and toluene are calculated from the two equations, and it is shown that these osmotic pressures can be satisfactorily expressed by the equation derived by van der Waals for gases. The absolute validity of Raoult's law for ideal solutions gives rise to problems in regard to mass and volume concentrations, which are to be dealt with later. F. J. B.

1073. Atomic Deformation by the Working of Metals. W. Geiss and J. A. M. van Liempt. *ZS. f. Phys.* 45. 9–10. *pp.* 631–634, 1927.

This research into the changes in electrical conductivity in corroded wolfram wires satisfies the view that by cold working the atoms are deformed. The authors conclude as a result of a former work as well as from the present investigation that the explanation of cold working rests upon an electron theory and not upon a structural geometrical view, and therefore is a physical and not a crystallographic problem. J. K.

1074. Classification of Metallic Substances. W. Hume-Rothery. *Phil. Mag.* 5. *pp.* 173–178, *Jan.*, 1928.

Chemical compounds are said to be distinguished from mixtures by having a fixed composition, by being decomposed only by chemical means and not by physical and mechanical means, and by having properties that cannot be calculated from the properties and proportions of the constituents. These criteria being unsatisfactory, the author proposes the following classifications and distinctions. Metallic elements may isotopically be simple or complex. Primary metallic solid solutions retain the crystal structure of the parent metal; they may form the end phases of equilibrium diagrams and may, by the X-ray spectrometer, be shown to be of the substitutional or the interstitial lattice type. In secondary solid solutions of intermediate composition the crystal structure differs from that of the parent metal, but there is no indication of compound formation or of exchange or transference of electrons. In intermediate compounds of fixed or variable composition there is indication of compound formation or electronic exchange. The previous suggestions of C. A. Edwards and of Westgren and Phragmén [see Abstract 2178 (1925)] introduced new conceptions of chemical compounds. H. B.

1075. Differentiation of Aluminium Alloys by the Hydrogen-Ion Concentration. C. Quillard. *Comptes Rendus*, 185. *pp.* 1281–1283, *Dec.* 5, 1927.

When foils of aluminium and its alloys are dipped into distilled water or sodium chloride solution (30 gm. per litre), to which some indicator (methyl blue, bromocresol, etc.) is added, the *p*H rises from 5·6 to 7·0 in the order: aluminium, alferium without magnesium, same with magnesium, alugir, duralumin, alferium. Similar observations are made with alloys of aluminium, with silicon and manganese. The effects are complex, however, owing to the surface layer formed during the process. Coloured zones and patches are also formed. The pure American metal of 99·8 % Al shows these patches and is more corrodible than French industrial metal. H. B.

1076. Some Properties of Electrolytic Nickel. B. Bogitch. *Comptes Rendus*, 185. *pp.* 1467–1469, *Dec.* 19, 1927.

This paper contains a comparative study of the properties of electrolytic nickel produced by different firms. The results are summarised in a table giving the chemical composition (*i.e.*, the percentage of the impurities cobalt, copper, iron, carbon and sulphur) and the resulting hardness, density, and rates of solution in hydrochloric, sulphuric and nitric acids. H. H. Ho.

1077. Chemical Affinity in Metallic Alloys, especially Solid Solutions. Compressibility. R. F. Mehl and B. J. Mair. *Am. Chem. Soc., J.* 50. *pp.* 55–73, *Jan.*, 1928.

Terminal solid solutions are simple in structure and show only the space lattice of the solvent metal, the atoms of the solute having merely replaced atoms of the solvent. Intermediate solid solutions are more complicated in structure. The behaviour depends upon chemical action and crystallographic tendency. The chemical affinity between unlike atoms and the partial fixing of valency electrons lead to a decrease in the electric conductivity of solid solutions and to an increase in hardness. The compressibility is directly related to the cohesive force (Richards). In elementary solids these cohesive forces are physical, electrochemical effects involving displacement of electrons being absent. In compounds the increase in cohesion caused by chemical action between unlike atoms is manifested by a decrease in compressibility. The authors determine the heat of formation of Al-Mg and Al-Zn alloys, critically discusses the available data on compressibility, and describes new measurements of sixteen alloys of Cu with Ni, Al, Zn, Sn and of Ni-Fe of various compositions and conditions (rolled, drawn, cast, annealed) at 25°. Compressibility is a measure of the lattice rigidity factor in hardness. For solid solutions the difference in the compressibility of solid solutions and the value calculated for the mixture is a measure of the chemical affinity between unlike atoms increasing the lattice rigidity. This compressibility measures chemical hardness, whilst slip resistance produces physical hardness. The greatest deviations from simple additivity occur in metals differing greatly in chemical type, and this is always negative deviation. The hardness of quenched steel is not due to an appreciable increase in the normal cohesive force, for the compressibility is not affected by quenching or annealing. H. B.

1078. Catalysis by Nickel of the Union of Hydrogen and Oxygen by a New Method. D. R. Hughes and R. C. Bevan. *Roy. Soc., Proc.* 117. *pp.* 101–108, *Dec.* 1, 1927.

The temperature to which a nickel wire is heated by a given current is higher when the metal is in hydrogen than when it is in a mixture of hydrogen and oxygen. Since the thermal conductivity of hydrogen is greater than that of oxygen, it is probable that the surface condition of the wire is different in the two cases, although no difference in appearance is perceptible. The view that the surface of the metal in the gaseous mixture is oxidised is confirmed by the behaviour under similar conditions of a wire which is visibly oxidised. It appears also that, on the average, a hydrogen molecule which comes into contact with the oxide surface and then escapes removes more energy than one escaping from the metal surface at the same temperature. The coefficient of radiation is found to depend on the thickness of the oxidised sheath. Measurements of the temperature coefficient of the resistance of a nickel wire give results from which the so-called accommodation coefficient of hydrogen—that is, the ratio of the heat removed from the surface by an escaping hydrogen molecule to that which should be removed if the molecule had acquired the temperature of the surface—is calculated to be 0·25 in contact with nickel and 0·48 in contact with oxidised nickel at 164°, the room-temperature being 14°; for oxygen in contact with oxidised nickel the value is 0·95. The rate of formation of water from hydrogen and oxygen in contact with nickel which has been used as a catalyst for this reaction does not differ appreciably from that observed with a visibly oxidised metal. Reduction in hydrogen of a nickel wire oxidised in the hydrogen-oxygen mixture does not start all over the outer surface of the oxide film; either the hydrogen penetrates the oxide film and the reduction occurs at the interface of metal and oxide, or, less probably for thin films, the reduction commences at nuclei and the tiny specks of metal grow and at the same time penetrate and expand over the oxide film. On the assumption that it is uniform, the film formed by bringing reduced nickel into contact with oxygen at the temperature of the laboratory has the thickness 3×10^{-7} cm., whereas that obtained by causing oxygen and hydrogen to combine in contact with the metal is about three times as thick. The thickness of visible films is much greater, being of the order of the wave-length of visible light. T. H. P.

1079. Studies of Gas-Solid Equilibria. Part I. Pressure-Temperature Equilibria between Benzene and (*a*) Ferric Oxide Gel, (*b*) Silica Gel in Sealed Systems of Known and Unalterable Total Composition. B. Lambert and A. M. Clark. *Roy. Soc., Proc.* 117. *pp.* 183–201, *Dec.* 1, 1927.

This investigation provides more accurate and reliable data than are at present available for the examination of the theoretical aspects of gas-solid equilibria. The principles of experiment employed are: (1) An accurately known weight (*in vacuo*) of the activated gel, in the form of small granules, is introduced into an all-glass apparatus, part of which consists of an evacuated mercury manometer; (2) after evacuation, an accurately known weight of benzene is distilled into the apparatus and the system sealed; (3) the latter is then heated in a vapour bath to definite temperatures within 30°–130° C. and the equilibrium pressure taken; (4) a number of such sealed systems is prepared containing gradually increasing weights of benzene and a series of pressure-temperature curves obtained for systems of different total composition. The shapes of the adsorption isothermals for the benzene-ferric-oxide gel systems appear to be markedly different from those of the closely analogous benzene-silica gel systems. From the data the adequacy of Zsigmondy's capillary theory to explain the adsorptive processes of inelastic gels would therefore seem to be very doubtful. H. H. Ho.

1080. Ionisation and Chemical Change during Slow Combustion. J. A. J. Bennett and E. W. J. Mardles. *Chem. Soc., J. pp.* 3155–3161, *Dec.*, 1927.

The changes which occur in gas mixtures, rendering them sensitive to inflammation, have been investigated. The spontaneous ignition temperatures of vapour and spray in air was determined for a number of liquids, the vapour having invariably the higher ignition temperature. The heated-tube method was used for the determinations. Chemical changes were found to occur below the ignition temperature, and these were usually more marked and occurred at a lower temperature when liquid drops were present than with the vapours alone. The influence of lead tetraethyl and iron carbonyl on the spontaneous ignition temperatures was determined, and the influence of lead tetraethyl, iron carbonyl, *m*-toluidine, *m*-xylidene, and *m*-cresol on the chemical changes during slow combustion of undecane was investigated. F. J. B.

1081. Oxidation of Phosphorus Vapours at Low Pressures. N. Semenoff. *ZS. f. Phys.* 46. 1–2. *pp.* 109–131, 1927.

According to Chariton and Walta [see Abstract 1207 (1927)] the oxidation of phosphorus vapours requires a minimum critical pressure. Bodenstein [see Abstract 1930 (1927)] would consider this as inexplicable, but suggested that, in the arrangement adopted, the McLeod gauge did not indicate the actual oxygen pressure. The author agrees, but he supports the critical pressure by further experiments made in conjunction with Schalnikoff. At low pressures, below a critical value, phosphorus and oxygen do not react at all with one another or react too slowly for observation. This critical pressure decreases as the distance apart of the walls of the containing vessel and the size of the vessel increase. The presence of a neutral gas (argon) has the same effect as increased size (volume or surface). Increase of the vapour pressure of either component, phosphorus or oxygen, lowers the critical pressure of the other. The reaction is a chain effect in the sense of Christiansen and Kramers. Oxygen atoms activated by heat form centres of reaction and create new centres by collisions with molecules. When these centres strike the walls, they are deactivated (poisoned). The longer the time intervals before a wall is reached, the smaller this poisoning effect; the presence of a neutral gas likewise retards deactivation. A reaction between the molecules P_4 and O_2 is impossible. H. B.

1082. Photochemical Reaction between Hydrogen and Chlorine. A. L. Marshall. *Am. Electrochem. Soc., Trans.* 49. *pp.* 143–179; *Disc.*, 179–180, 1926.

A summary is given of the work on this reaction up to the elucidation of the mechanism of the induction period, which is caused by the presence of nitrogenous substances capable of yielding volatile nitrogen compounds. The expansion of moist chlorine gas on illumination, termed the Budde effect, is shown to be purely thermal in nature and to be absent in the dry gas. A somewhat similar effect in a mixture of hydrogen and chlorine is called the Draper effect and is due to the heat liberated in the combination. This effect is followed by a definite after-reaction far exceeding in magnitude the initial photochemical effect. The reaction reaches its maximum rate 0·05 to 0·01 second after the illumination and is greatly influenced by traces of water vapour. When the water vapour pressure is less than 10^{-7} mm., the reaction is not affected by visible light, and proceeds only with wave-lengths less than 300 $\mu\mu$. With a concentration greater than 10^{-5} mm., the reaction is independent of the water vapour concentration. Direct measurement shows that a sensitive mixture of hydrogen and chlorine yields 10^5 molecules of hydrogen chloride per quantum of light absorbed, and for a given mixture the quantum yield appears independent of the light intensity. The rate of formation of hydrogen chloride is proportional directly to the square of the chlorine concentration and inversely to the oxygen concentration. Various refinements to the equation are suggested, but more data are required. The mechanism of the reaction may involve either chlorine atoms or activated molecular chlorine. Recent physical research appears to indicate that light is able to dissociate chlorine into atoms, and thus to favour the atomic mechanism. The temperature coefficient of the photochemical reaction is a function of the wave-length, varying from 1·17 for ultra-violet to 1·31 for blue light. Low-pressure studies show that the quantum yield varies from 20 mols. at 0·001 cm. to 25,000 mols. at 6 cm. pressure. [See Abstracts 2394 (1925); 882, 2481 (1926).] T. H. P.

1083. Action of Light on Nitrated Dyestuffs. A. Seyewetz and D. Mounier. *Comptes Rendus*, 185. *pp.* 1279–1281, *Dec.* 5, 1927.

Some nitrated phenols and amino-compounds, fixed on vegetable or animal fibres, do not fade when exposed to light or ultra-violet radiations, but turn brown. Certain non-coloured compounds behave similarly, and the OH and NH_2 groups do not appear to be essential for the effect. When cotton and calico are so treated and washed in water, the altered compound remains fixed in the fibre and cannot be extracted by alkali and precipitated with picric acid. The nitro-group appears to be reduced and some azo-compound to be formed. H. B.

1084. Velocity of Interaction of Ions. F. G. Soper. *J. Phys. Chem.* 31. *pp.* 1790–1797, *Dec.*, 1927.

An equation for the rate of interaction of ions was developed, in which the potential energy possessed by the ions in virtue of their charges was regarded as contributing to the critical increment of the reaction. The potential energy of the ions was evaluated from the Debye-Hückel theory and the equation $\log k = C + 0{\cdot}66 Z_a Z_b \sqrt{\mu}$ was derived, where k is the velocity coefficient, Z_a and Z_b the valencies of the ions and the ionic strength. The equation was tested on reactions of various ionic types by determining P in the equation $\log k = C + P Z_a Z_b \sqrt{\mu}$ by a graphical method. The average value of P was found to be $0{\cdot}62 \pm 0{\cdot}13$. F. J. B.

1085. Influence of Radiation in Thermal Unimolecular Reactions. J. E. Mayer. *Am. Chem. Soc., J.* **49.** *pp.* **3033–3046,** *Dec.,* **1927.**

Measurement of the absorption coefficient for black body radiation at low temperatures gives with nitrogen pentoxide values of sufficient accuracy to show that the rate of activation of the pentoxide is not rapid enough to account for the observed velocity of decomposition. If higher and higher steps of energy acquisition are considered, the relative importance of the absorption of radiation increases in comparison to the transfer of energy by collisions. As regards the possibility of activation by the absorption of low energy radiation by molecules of high energy existing in equilibrium numbers, it would be necessary, if this process is to play some important part in the normal mechanism of activation, that such molecules of abnormal energy (but unactivated) possess an enormously higher absorption coefficient than the normal molecule. The study of the behaviour of pinene under the influence of radiation in a molecular stream in conditions such that there were no collisions and the gas concentration was sufficiently low to avoid decrease in the radiation density by absorption in the outer layer gave no indication of the occurrence of racemisation. T. H. P.

1086. Laws of Impact of Molecules which possess Surfaces Reactive towards Gases. Part I. A. Predwoditelew. *ZS. f. Phys.* **46. 5–6.** *pp.* **406–419, 1928.**

This paper investigates and modifies Carter's conclusions [see Abstract 665 (1898)] respecting the velocities of reacting molecules. A comprehensive theoretical examination of the impact of reacting molecules is first given and is then followed by an experimental confirmation of the formulæ obtained. For the latter purpose a special type of balance has been devised, full details of which are given. H. H. Ho.

1087. Brominated Silver instead of Platinum for Electrochemical Apparatus. W. A. Roth. *Z. El. Chem.* **33.** *pp.* **508–511,** *Nov.,* **1927.** *Paper read before the Deut. Bunsen Gesell., Dresden, May,* **1927.**

Electrodes and vessels for conductivity measurements may be made of silver (instead of platinum and gold), when the silver is coated with a film of AgBr, produced either by treatment of the silver with bromine water (bromine dissolved in BrH of $1 \cdot 5\ N$) or better with bromine vapour. In the latter case it is advisable to form one film of bromide, heat the electrode until the bromide fuses, and then expose it to the vapour once more. Silver chloride (too soluble) and iodide (occurring in two modifications) are not suitable. But silver wires cannot replace platinum wires to carry the current through glass. The author describes some lecture experiments and electrometric titrations made with these apparatus and a telephone, by preference to a galvanometer. In this way the solubility of calcium oxalate in water and the preferential adsorption of potassium (rather than sodium) salts by the soil, as well as the electrolytic nature of CO_2, can be proved. H. B.

1088. Valve Effect shown by a Silicon Anode and its Mechanism. R. Audubert. *Comptes Rendus,* **185.** *pp.* **768–770,** *Oct.* **17, 1927.**

Cells showing a valve effect (unilateral conductivity) are formed from a silicon anode and a metallic kathode in either acid or alkaline solutions.

It is suggested that the effect is due to anodic oxidation of the silicon, which becomes covered by a layer of non-conducting silica, followed by reduction with kathodic hydrogen. The effect was most closely examined in a cell of the type $Si|10\% H_2SO_4|Pb$, and was found to be an exponential function of the temperature. L. M. C.

1089. Cuprous Chloride Electrodes. R. F. Nielsen and D. J. Brown. *Am. Chem. Soc., J.* 50. *pp.* 9–19, *Jan.*, 1928.

Measurements of the cell Cu (in two-phase amalgam) : $CuCl(s)$: HCl : H_2 show that the standard potential of the copper amalgam-cuprous chloride electrode is expressed by: Cu (in two-phase amalgam) $+ Cl^- = CuCl(s) + E^-$; $E^0 = -0{\cdot}1298$ volt, $\Delta F^0_{298} = 23074{\cdot}0 \times 0{\cdot}1298 = 2995$ cal. For this electrode Noyes and Chow [see Abstract 1136 (1918)], using copper plated on platinum, found $-0{\cdot}1220$ volt, but it appears that the smooth copper plate used contained energy in the form of distortion from a more stable form of copper. Measurements of the cell Cl_2 (at low pressures): $CuCl_2$(aq.) : $CuCl(s)$ give for the standard potential of the cuprous chloride-cupric chloride electrode, $CuCl(s) = Cl^- + Cu^{++} + E^-$; $E^0 = -0{\cdot}5758$ volt, $\Delta F^0_{298} = 23074{\cdot}0 \times 0{\cdot}5758 = 13{,}285$ cal., as well as the activity of cupric chloride over a limited range. To ensure reliable results, copper amalgam was used instead of metallic copper, oxygen was excluded, and the electrodes were rotated in the thermostat. Chemical reactions affecting the concentration of chloride ion are considered mathematically and corrections made for them. The questions of the liquid junctions and the trend of the activity coefficients are also considered.

The standard free energies of the two solid chlorides and of aqueous cupric chloride are calculated to be as follows:

Cu (in two-phase amalgam) $+ \frac{1}{2}Cl_2(g) = CuCl(s)$: $\Delta F^0_{298} = -(1{\cdot}3594 - 0{\cdot}1298)23074 = -28370$ cal.

Cu (in two-phase amalgam) $+ Cl_2(g) = CuCl_2$(aq. at unit activity): $\Delta F^0_{298} = -46450$ cal.

Cu (in two-phase amalgam) $+ Cl_2(g) + 2H_2O(l) = CuCl_2, 2H_2O(s)$: $\Delta F^0_{298} = -44100$ cal.

The standard free energies of several other reactions are also calculated [see Abstract 494 (1928)]. T. H. P.

1090. Cells with Unalterable Electrodes and Carnot's Principle. V. Karpen. *Comptes Rendus*, 186. *pp.* 230–232, *Jan.* 23, 1928.

A platinum electrode covered with platinum black and a graphite plate were suspended in a saturated aqueous solution of sodium hydroxide kept at 95–100° C. for 16 hours. The e.m.f. between these electrodes on open circuit was 0·5 volt, as described in the two previous papers. During the time of the experiment, 11 coulombs of electricity were discharged, corresponding to a calculated loss in weight of 5·5 milligrammes of platinum from the electrode. The amount actually lost was 0·1 milligramme. The possibility that reaction occurs at the positive graphite electrode is considered and rejected. It is concluded that the second law of thermodynamics is invalid in this case. [See Abstracts 772 and 773 (1928).] L. M. C.

1091. Application of the Quinhydrone Electrode to the Electrometric Titration of Acids. A. Kilt. *Zeits. phys. Chem.* 131. *pp.* 61–80, *Dec.*, 1927.

The limits of concentration and the strength of acids on the applicability of the quinhydrone electrode to electrometric titration was investigated. It was shown that the quinhydrone electrode can be used for the titration of weak acids with a 0·1 *N* base if the initial concentration of the acid is 0·1 *N*, and $K \geq 10^{-7}$. If the concentration is 0·005 *N*, then K must not be less than 10^{-6}. During the whole of the titration nitrogen must be passed through the solution so as to prevent absorption of carbon dioxide leading to false results. Dissociation constants obtained from the basis of the *p*H values at the half-neutralisation point showed a good agreement with the recorded values. F. J. B.

1092. Potentiometric Titration of Boric Acid in the Presence of Certain Inorganic Salts. M. G. Mellon and F. R. Swim. *Indust. and Engin. Chem.* 19. *pp.* 1354–1355, *Dec.*, 1927.

The potentiometric titration of boric acid alone and with the addition of certain inorganic salts was studied. The salts were sodium chloride, lithium chloride and calcium chloride. The results are plotted with *p*H values and concentration of salts as coordinates. The results indicate that the addition of polyhydric alcohols, such as glycerol, is preferable to the use of inorganic salts for improving the end point of the titration. F. J. B.

1093. Theory of the End Point in Electrometric Titration. P. S. Roller. *Am. Chem. Soc., J.* 50. *pp.* 1–8, *Jan.*, 1928.

In the electrometric titration of a monobasic acid by a strong base the inflection point in the e.m.f. titration curve will appear if $cK_a = 27K_w$, where K_a is the ionisation constant of the acid, K_w the ion product constant of water, and c is a concentration defined by the equation $\frac{1}{c} = \frac{1}{a} + \frac{1}{b}$, where a is the initial concentration of the acid and b the initial concentration of the base in the titrating solution. Simple equations are given for the difference in *p*H and in c.c. of titre between the inflection point and the end point. The differences increase with the weakness of the acid and with dilution. The tendency of the titration curve to compress into a straight line in the neighbourhood of the inflection point leads to an error in locating the inflection point, and this error becomes greater the weaker the acid and the greater the dilution. F. J. B.

1094. Electrolytic Transference of Water in Aqueous Hydrobromic Acid. G. Baborovský and A. Wagner. *Zeits. phys. Chem.* 131. 3–4. *pp.* 129–133, *Jan.*, 1928.

Continued experiments [see Abstract 493 (1928)] with HBr are made in two parallel series, the membrane of parchment paper separating either the anode or the kathode compartment from the solution. Neither the true transference numbers of the kation (1 — N) nor the transferences of water (expressed in mols. of water) were very concordant, probably owing to membrane effects. The transference number for the kation $(1 - N)_H$ is 0·897 from the kathode data and 0·859 from the anode data, the mean being 0·878. The water travels to the kathode, the Ξ found being 0·50, against Remy's value 0·61. The Ξ of the authors denotes the total (electrolytic plus electroosmotic) transference; in normal solutions Ξ and ζ would be the same. The Br-ion travels with 3·08 mols. of water.

H. B.

1095. Preparation and Properties of Metallic Yttrium. A. P. Thompson, W. B. Holton and H. C. Kremers. *Am. Electrochem. Soc., Trans.* 49. *pp.* 277–287; *Disc.*, 287–289, 1926.

A series of attempts to prepare metallic yttrium were made. It was not possible to reduce the oxide Y_2O_3 with carbon. The electrolysis of Y_2O_3 in cryolite yielded only aluminium. The electrolysis of YCl_3 from non-aqueous solutions gave unsatisfactory results. The reduction of YCl_3 with metallic calcium yielded metallic yttrium in powder. Metallic yttrium was obtained by the electrolysis of fused YCl_3 with small amounts of NaCl. Considerable quantities of crystalline yttrium powder and four grammes of the metal in a coherent form were obtained. The metal is highly crystalline, is brittle, shows a bright fracture, and tarnishes slowly. It is acted upon by hot water and acids, and at elevated temperatures it becomes a vigorous reducing agent. The specific gravity is 4·57 at 15° C. The metal is not pyrophoric, and its iron alloys are brittle and resistant to acids.

F. J. B.

1096. Electrochemical and X-Ray Studies of Lead Deposits. P. K. Frölich, G. L. Clark and R. H. Aborn. *Am. Electrochem. Soc., Trans.* 49. *pp.* 369–390; *Disc.*, 390–393, 1926.

Lead electrodeposits from acetate, nitrate, perchlorate, fluoborate, and fluosilicate electrolytes, in the presence and absence of free acid and of gelatine as an addition agent, were studied from the standpoint of potentials and of the crystalline structure as revealed by X-ray analysis. From the evidence of the experiments the deposit from perchlorate in the presence of excess acid and of gelatine is best. The results confirm present views as to the effect of the different variables on the structure of electrodeposited metals, with the one exception that preferred orientation (fibre structure) in Pb, contrary to observations on Fe, Ni, etc., increases with an increase in current density, although the grain size decreases as for other metals. The current density-potential curves indicate that the resistance met with in kathodic formation of crystals is small for Pb.

J. J. S.

1097. Becquerel Effect. Part I. C. Winther. *Zeits. phys. Chem.* 131. 3–4. *pp.* 205–213, *Jan.*, 1927.

The name "Becquerel effect" is used to denote two different groups of the action of light upon solutions. It is used for the volume change brought about by photochemical means in solutions of electrolytes, and it is used to describe the photogalvanic effects which are brought about at electrodes and which require electrodes for their measurement. The author proposes to limit the term "Becquerel effect" to the latter group. The substances which are most active as Becquerel electrodes were shown to be those having a great surface and a corresponding great power of adsorption, and become better conductors when illuminated. The Becquerel effect has its origin in ionisation, followed by a change in the adsorption equilibrium. The chemical processes which often accompany the Becquerel effect are to be considered as secondary to the main reaction.

F. J. B.

1098. Electrochemical Behaviour of Glass. M. J. Mulligan and J. B. Ferguson. *Roy. Soc. Canada, Trans.* 21. *Sect.* 3. *pp.* 263–264, *May*, 1927.

Soda-lime glass was electrolysed, using a difficult soluble anode, such as mercury or carbon. At temperatures between 300° C. and 400° C. the current decreased to a small amount as the electrolysis proceeded. The reason of this is shown to be due to the formation of highly resistant layers, but the chief cause was the setting up of counter-e.m.f.'s which may be nearly equal to the applied voltages. F. J. B.

1099. Electrolytic Disintegration of Glass. P. Selényi. *Ann. d. Physik*, 84. 1. *pp.* 111–118, *Sept.* 10, 1927.

If ordinary glass is subjected to electrolysis in which an ionised gas is employed as insoluble anode the glass is disintegrated, Na is set free at the kathode and O at the anode, and at the anode there is formed a badly conducting layer of silicic acid. This electrolytic disintegration of the glass may be observed with any vacuum glow lamp. (The bulb may be immersed in a bath of saltpetre at 200–250° C., or may be covered with tinfoil.) When the lamp is inserted and the outer covering connected with the positive pole of the lamp a stream of electrons flows through the gas space of the bulb and brings metallic Na into the lamp. If the outer covering is made the kathode, then a current of positive ions to the bulb and oxygen is set free in the gas space. J. J. S.

1100. Persistence of Potential at a Mercury Kathode on Open Circuit. F. P. Bowden, Jr. *Faraday Soc., Trans.* 23. *pp.* 571–583, *Sept.*, 1927, *and Disc.* 24. *pp.* 233–235, *April*, 1928.

After prolonged electrolysis of dilute sulphuric acid the overpotential at a mercury kathode on opening the circuit persists for several hours. This persistence must be due either to active hydrogen or to negative metal impurities. Experimental evidence is advanced to show the latter is the case, and these impurities are identified as Na, Mg, Al, Zn, Pb and As. The amount of impurity necessary is very small, being less than 10^{-6} gramme-equivalents. It is shown that the hydrogen-ion concentration in the vicinity of the kathode may be very different from that obtaining in the bulk of the electrolyte and that this has an important influence on the rate of fall of the potential, so that even in apparently pure solutions the potential of a kathode on open circuit is controlled by traces of negative metal impurities on its surface. It is apparent that the measurement of these potentials can throw little light on the true hydrogen overpotential. Moreover, since the decay curves are not smooth, measurement of the back e.m.f. at set intervals after the circuit is opened and extrapolation to zero-time may give a quite erroneous value for the potential at this instant. The presence of these impurities offers a satisfactory explanation of the "hydrides" observed at a mercury kathode. In general, in order that kathodic back e.m.f.'s may be interpreted with confidence as hydrogen overpotential phenomena, it is necessary to ensure that metallic impurities of the order of $<10^{-6}$ gramme-equivalents have not been deposited on the kathode surface. Under most experimental conditions impurities are present in amounts greater than this. This also offers a method complementary to that of Heyrovsky for the detection and identification of traces of impurities in solution. J. N. P.

1101. Electrolytic Oxidation of Para-Toluic Acid in Alkaline Solution. A. J. Allmand and A. Puttick. *Faraday Soc., Trans.* 23. *pp.* 641–650, *Nov.*, 1927.

Electrolytic oxidation of organic compounds has been little used in comparison with kathodic reduction owing to the relative sluggishness of the reaction of the anodic oxygen with the polariser and also because the reversible potentials for the onset of the oxidation and for the evolution of the gaseous oxygen generally lie near to one another. In certain cases the superposition of an alternating current on the direct current produces considerable yields of the desired product. This has been done in inorganic electrochemistry, and by this means Reitlinger has increased the current efficiency of electro-oxidation of ethyl alcohol to acetaldehyde in dilute sulphuric acid solution at platinum anodes. The authors endeavoured to apply the same method to the case of oxidation of *p*-toluic acid in alkaline solution to terephthalic acid, but were not successful; there was no increase in the terephthalic acid yield. Details of the experiments and the results obtained are given. J. J. S.

1102. New Method of Measuring Overvoltage. L. J. P. Byrne. *Faraday Soc., Trans.* 23. *pp.* 661–667, *Nov.*, 1927, *and Disc.* 24. *pp.* 233–235, *April*, 1928.

When an electrolyte is submitted to electrolysis the potential difference E between the electrodes is composed of two distinct portions: (1) the ohmic potential fall due to the passage of the current along the column of electrolyte, and (2) a pure e.m.f. effect at the two electrodes, this being the sum of the overvoltages at the two electrodes. If the current flowing be I amperes and the ohmic resistance of the cell R ohms, the total overvoltage is $(E - IR)$ volts. In the method here described these three quantities are measured. The cell is placed in an alternating-current bridge, by means of which its resistance is measured. The polarising source is isolated by means of chokes possessing a very high impedance at the frequency used in the bridge yet presenting but a low resistance to direct currents. The ammeter is placed in this circuit, while the p.d. across the cell is measured by means of a very high-resistance voltmeter. Thus all three measurements may be made simultaneously while the current is actually flowing, giving overvoltages with a degree of certainty never previously attained. The method may be used at any current density. Details of the arrangement are given. The method is used to show how overvoltage varies with current density in neutral and acid copper-sulphate solutions. No definite relation between overvoltage and the relative directions of the current and the electrolyte circulation is detectable. T. H. P.

1103. Current-Voltage Curves in the Passivation of Different Metals. W. J. Müller. *Z. El. Chem.* 33. *pp.* 401–406, *Oct.*, 1927. *Paper read before the Deut. Bunsen Gesell., Dresden, May*, 1927.

Curves are plotted to show the relation obtained between current and anodic potential when varying potentials are supplied between a large kathode and an anode of small area. When passivity of the anode is obtained, the current remains constant or falls on further increase of potential until, at a certain potential, a different electrolytic reaction takes place when the current increases. The characteristic effects obtained with iron, nickel and chromium are illustrated. With iron, passivity is preceded by the formation of a film of a basic salt or hydroxide of iron, which causes an increase of current density locally. A transformation of the metal to the passive state then occurs through the influence of this high current density. Iron while active dissolves anodically at all current densities without any measurable polarisation, but active nickel to pass into solution requires an anodic overvoltage of about 0·4 volt. By the use of an oscillograph, it is shown that there is no appreciable anodic polarisation with chromium, even for a short interval, until a critical current density is reached, when the metal becomes unattackable. [See also Abstract 2609 (1924).] J. N. P.

1104. Behaviour of Nickel Anodes. F. Foerster and F. Krüger. *Z. El. Chem.* 33. *pp.* 406–423; *Disc.*, 423–425, *Oct.*, 1927. *Paper read before the Deut. Bunsen Gesell., Dresden, May*, 1927.

The results are given of an investigation into the nature and degree of the action of additions of chloride on the anodic behaviour of nickel in nickel sulphate solutions. Among other results it is found that the peeling-off of nickel in moderately strongly acid solutions, hence, when the anode is passive, depends on the iron content, whereas with active anodes it is conditioned by transference of nickelous hydroxide into the electrolytic nickel by excessive diminution of the hydrogen-ion concentration. Electrolytic nickel *per se* exhibits no tendency to peel. Probably owing to the change of its hydrogen content in superposed layers, it shows internal stresses, but these manifest themselves only in bending of nickeled kathodes coated on only one side. Although a good nickel precipitate is obtained with completely passive anodes, in technical nickel-plating such conditions are to be avoided, since the current yields are too low and it is practically impossible to keep the electrolytes free from small proportions of iron for a long time. The only convenient way of achieving good galvanic nickeling permanently and certainly is to work with perfectly active anodes with good current yields, to watch carefully the *p*H of the bath, and to replace periodically the hydrogen ions used. The permissible upper limiting *p*H value is not constant under all conditions, but varies with the nature of the electrolyte and must be determined in each case. Of importance for regular working is the maintenance of the complete activity of the anodes. Experiment shows that this is effected by an addition of chlorine ions, in the form of nickel chloride and in an amount dependent upon the nature of the anode and the anode current density. Transitory passivity of the anode should be avoided; in the presence of chlorine ions it is recognised by a faint smell of chlorine as well as by variations in the voltage. Such passivity conditions irregularity of the p.d., current strength, acidity, and current yield, and, under certain conditions, the deposition of the nickel peroxide formed as a thick layer on the anode and the formation of anode sludge in considerable quantities. T. H. P.

1105. Air-Liquid Boundary Potentials with Electrolytes and with Pure Water. A. Bühl. *Ann. d. Physik*, 84. 2. *pp.* 211–244, *Oct.* 4, 1927.

Measurements are made of the air-liquid boundary potentials with simple electrolytes at varying concentration by the method employed by Bichat and Blondlot, in which the solution is allowed to proceed from a carefully insulated mass and issue rapidly from the narrow orifice of a tube in the form of drops. In accordance with Helmholtz's theory the main body of the solution will become charged to the potential of the boundary surface. The drops are allowed to fall through a nozzle in a tube containing an annulus of a second comparison electrolyte which flows down the internal wall of the tube. Determinations are made by a compensation method of the potentials between the two electrolytes, which thus gives a measure of the difference of the air-liquid boundary potentials of the two solutions. Measurements are made with aqueous solutions of hydrogen and alkali chlorides at concentrations from $0 \cdot 0001\ N$ to $0 \cdot 1\ N$. At higher dilutions it is necessary to apply a correction for the stream or electrophoretic potential, which is estimated by measuring the potential when the apparatus is inclined, so that the dropping electrolyte makes actual contact with the comparison electrolyte. In all measurements the ratio of concentration of the two solutions is taken as 1 : 10. With alkali chlorides a maximum value of the boundary potential difference is obtained at definite concentrations. With increasing mobility of kation this maximum is displaced towards lower concentration. Diffusion potentials which enter into the chain are calculated. The Nernst formula with the assumption of complete dissociation and ionic mobilities not varying with concentration is found unsuitable, and is replaced by Planck's formula. The results of the determination of diffusion potentials support the view that the electrolytes are completely dissociated, while only the ionic mobility changes with concentration. By extrapolating the values of the boundary potentials of alkali chlorides to infinite dilutions. It is estimated that the p.d. at the surface of pure water amounts to $5 \cdot 5 \pm 0 \cdot 5$ millivolt. J. N. P.

1106. Physical Interpretation of Electrolytic Solution Tension. A. v. Hippel. *ZS. f. Phys.* 45. 7–8. *pp.* 471–475, 1927.

In this paper electrolytic solution tension is shown to exist through a stepwise ionisation by hydratation, and the connection is formulated between electrochemical normal potentials and atomic physical data. H. H. Ho.

1107. Further Experiments on the Influence of Field Intensity upon Electrolytic Conductivity. M. Wien. *Phys. Zeits.* 28. *pp.* 834–835; *Disc.*, 836, *Dec.* 1, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

Experiments made with Kärst, as before [see Abstract 2754 (1927)], but at higher concentrations, indicate an increased heat effect, but a decreased potential effect, such that the total effect is a decrease of $\Delta\lambda_0$, which has only ½ or ¼ of its value when the concentration rises from $0 \cdot 001$ to $0 \cdot 016$. Other experiments by F. Bauer, made with acetone (not water) as solvent, show a much increased potential effect in acetone, to four times the value for ions of the same valency; this is ascribed to the lower dielectric constant of acetone. In the *Discussion*, **Gyemant** suggested ionisation in the insulating liquids, referring to his experiments [see Abstract 368 (1926)], which the author did not accept as cognate to his own. H. B.

1108. Behaviour of Debye's Electrolytes in Intense Fields. G. Joos and M. Blumentritt. *Phys. Zeits.* 28. *pp.* 836–838, *Dec.* 1, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The deviation of electrolytes from Ohm's law observed by Wien [see Abstract 2754 (1927)] might be ascribed to three causes : (1) A chemical effect due to the destruction of complexes in intense fields; (2) the diminution of the frictional resistance of the solvent owing to the heating and decrease of the viscosity—these two effects are quantitatively insufficient; (3) the mutual braking effect of the ions, which is of complex nature. There is first an electrophoretic effect because each ion drags an atmosphere with it, and secondly a relaxation force, due to the relative motion of the ion with respect to its atmosphere, the charge being symmetrical (spherical) as long as the ion is at rest, but becoming asymmetrical when the ion moves. The authors find that (3) would explain Wien's observation, at least in some cases, when higher order terms are considered which Debye neglected. As regards valency the observed effect is too small for $AlCl_3$ and K_4FeCy_6, but too large for $CuSO_4$ (this probably owing to hydrolysis). In reply to **Zahn**, the authors added that the consideration concerns only highly diluted solutions. H. B.

1109. Electrolysis of Potassium Chloride Solutions by Alternating Currents. A. J. Allmand and H. C. Cocks. *Chem. Soc., J. pp.* 2626–2639, *Oct.*, 1927.

The alternating-current electrolysis of solutions of potassium chloride at room-temperature with polished platinum electrodes is investigated and a determination made of the influence on the hypochlorite current efficiency of changes in concentration, current density, and frequency and the effects of adding free alkali or a chromate. Measurements are made of the maximum hypochlorite concentration possible under the conditions of electrolysis and of the average electrode potentials during electrolysis under different conditions. J. N. P.

1110. Electrolysis of Radioactive B- and C-Products and of Polonium. H. Raudnitz. *Akad. Wiss. Wien, Ber.* 136. *2a. No.* 7. *pp.* 447–451, 1927.

The electrical deposition of RaC and polonium and its dependence upon the concentration of the acid was investigated. It was shown that RaC practically free from RaB was obtained in a *n*/2 solution of nitric acid, the deposition taking place at the kathode. The deposition of polonium from a solution of radium and lead nitrate showed a maximum of separation of polonium at the kathode was obtained in a *n*/2 solution of nitric acid. F. J. B.

1111. Electrolytic Deposition of Chromium from Chromic Acid Solutions. E. Liebreich. *Z. El. Chem.* 34. *pp.* 41–42, *Jan.*, 1928.

Critically examining the experimental data of Stscherbakow and Essin [see Abstract 2653 (1927)], the author points out that the calculations indicate deposits of trivalent chromiums only in electrolytes which contain 16·5 % by weight, and more of H_2SO_4. At lower concentration of the sulphuric acid divalent chromium ions are deposited. H. B.